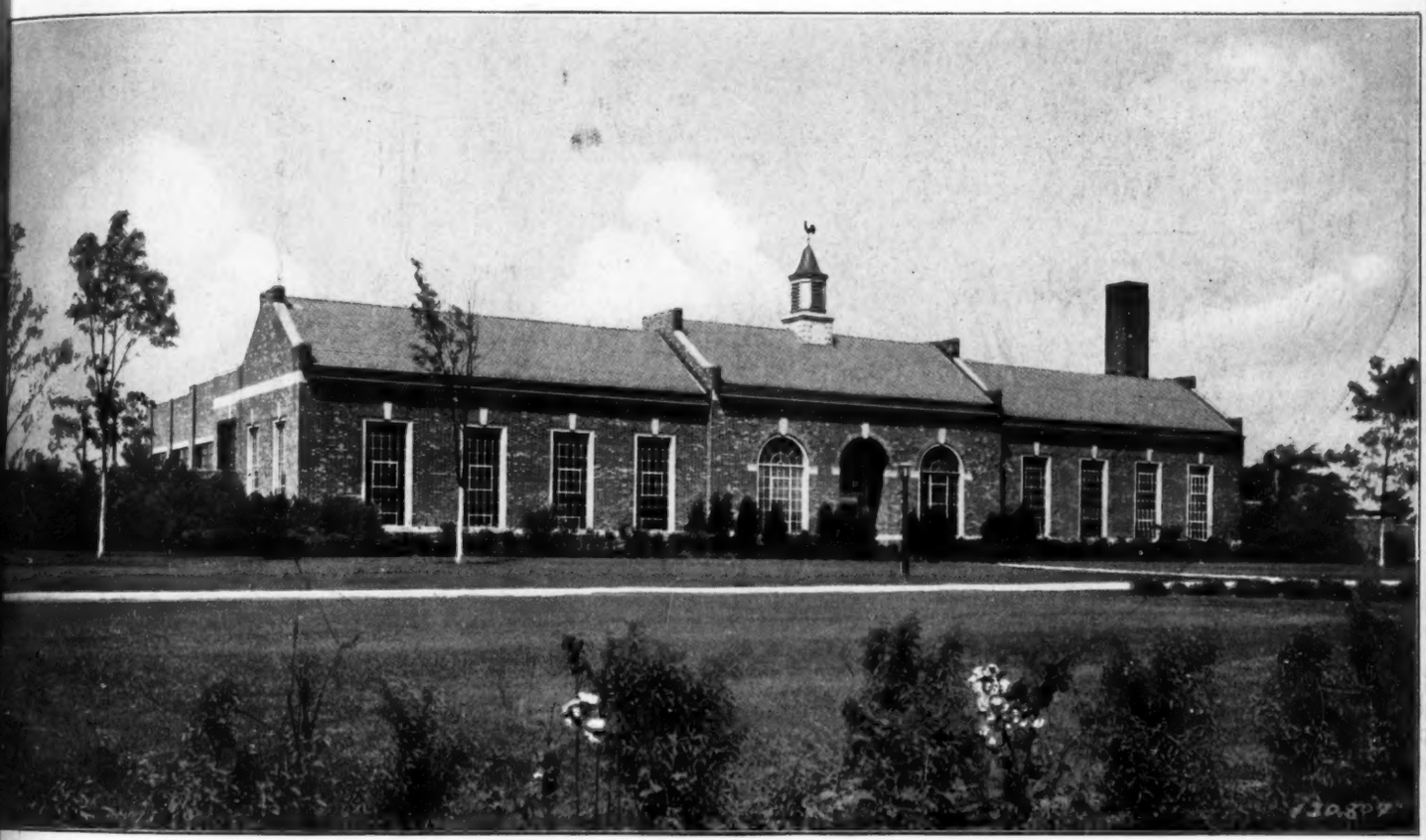
WATER WORKS AND SEWERAGE

A GILLETTE PUBLICATION

August, 1935 — L. H. Enslow, Editor — Vol. LXXXII. No. 8



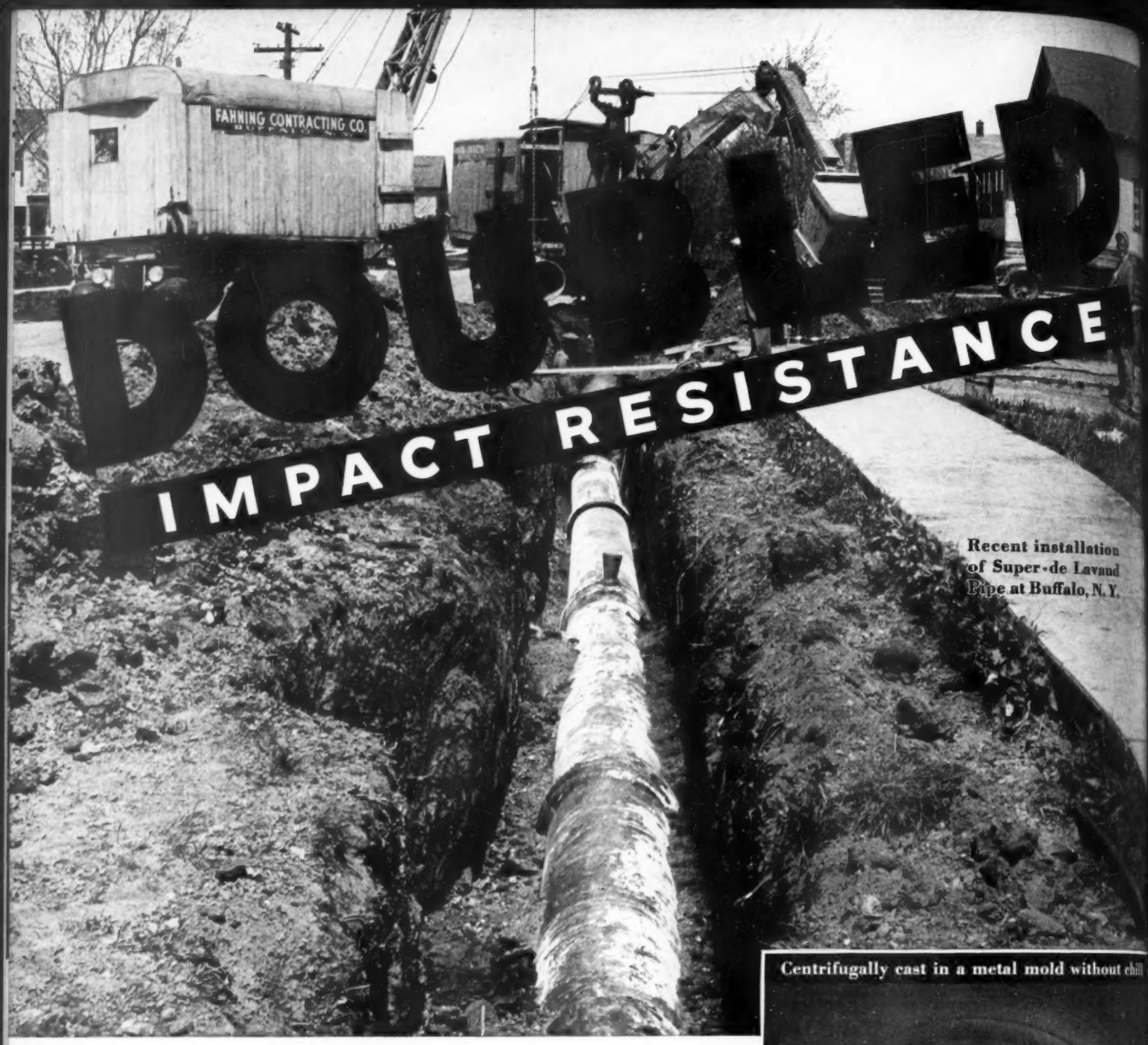
The First Modern Chemical Sewage Treatment Plant in America—that of Dearborn, Mich. (Hubel, Hartgering and Roth, Engineers; Mark B. Owen, City Engineer.)

IN THIS ISSUE

Sludge Incineration at Dearborn
William Mulholland—Hydraulic Engineer
The Cycles That Cause the Present Drought
Installation and Performance of Battery Meters
Water Works Finances—Past, Present, and Future
Meetings of the Pennsylvania Water Works Operators and Sewage Works Associations

DESIGN · CONSTRUCTION · COLLECTION
TREATMENT · DISTRIBUTION · DISPOSAL

DOUBLED IMPACT RESISTANCE



Recent installation of Super-de Lavaud Pipe at Buffalo, N.Y.

WE MAKE both pit-cast and centrifugally-cast pipe. Our production and laboratory facilities have been, and continue to be, devoted to improving both types of pipe to the limit of the potentialities of each method. Our test-records for two years, confirmed in the field through the installation of nearly 9-million feet, convince us that Super-de Lavaud Cast Iron Pipe is the strongest, toughest, most ductile pipe we have ever produced. Super-de Lavaud Pipe is *centrifugally cast in a metal mold without chill.* Impact strength is *doubled* without loss in tensile or bursting strength. The process is described in a booklet sent on request.

Centrifugally cast in a metal mold without chill

U.S. SUPER-de LAVAUD PIPE

CAST WITHOUT CHILL IN A METAL MOLD

UNITED STATES PIPE AND FOUNDRY CO., General Office: BURLINGTON, N. J.

WATER WORKS & SEWERAGE

L. H. ENSLOW,
Editor

LEADING ARTICLES To Appear in the Next and Subsequent Issues

Spartanburg's Elevated Tank and Special Sprinkling Rates: R. B. Simms, Supt. of Water Works and Sewage Disposal, Spartanburg, S. C., in the next issue, will tell of the benefits derived from the recently completed elevated tank (P.W.A.) project. The net result has been to add flexibility to the distribution system, making feasible the offering of special reduced summer sprinkling rates, without overloading the mains and pumping facilities during periods of peak drought. Making for home beautification, consumer good-will, better pressure regulation, and also some probable financial profit to the water department, this betterment is one which was well chosen as a P.W.A. project.

"The Spray Drying of Sewage Sludge"—is the title of a contribution from John R. Downes, which reveals operating results and operating cost data during a period of several months service of the pioneer installation of the Spray Sludge Drier which is located at the Plainfield (N. J.) Joint Sewage Treatment Works, of which the author has charge.

"Elements of Water and Sewage Works Meters"—by L. D. Carlyon, M. E., Bailey Meter Company, Cleveland, O., constitutes a discussion of the fundamental principles, applications, and relative merits of the Venturi tubes, flow nozzles and orifices, as applied to the measurement of water, air, sewage and sludges. To the novice the treatment of the subject is all new, to the experienced it has that value of being memory refreshing and also in several particulars, entirely new.

"Filter Runs With Anthrafilt vs. Sand"—tells of the results of tests in which crushed anthracite coal was compared with sand in filtration studies. The article sets forth the assumed reasons and theory to explain the longer runs of the anthracite filters between washings and their greater ease of washing as compared to the sand filters. The article is one of the series from the Anthracite Institute, with Messrs. H. G. Turner and G. S. Scott as the authors.

"Operating Experiences at the Newark, N. Y. Sewage Treatment Works"—are to be revealed by Thomas J. Smith, Chief Operator of Newark's modern activated sludge plant which has many of the newest developments in plant design incorporated. Mr. Smith relates their troubles and how corrected, and reports the results of several measures introduced to improve plant efficiency and reduce operating costs to a figure justifying the pride manifest in the records.

"A Method of Clearing Choked Service Lines" which is to be described by S. H. Davis, Supt., Benwood and McMechen Water Company, Benwood, W. Va., has proved simple, economical and effective. It involves the use of a cylinder of compressed air which "shoots" a 2 inch slug of rock salt "buckshot" through an armored hose connection to the service line. The high pressure surge of the compressed air and scouring effect of the salt "shot" does the job of recovering the depreciated capacity of the service pipe. The operation requires 15 minutes.

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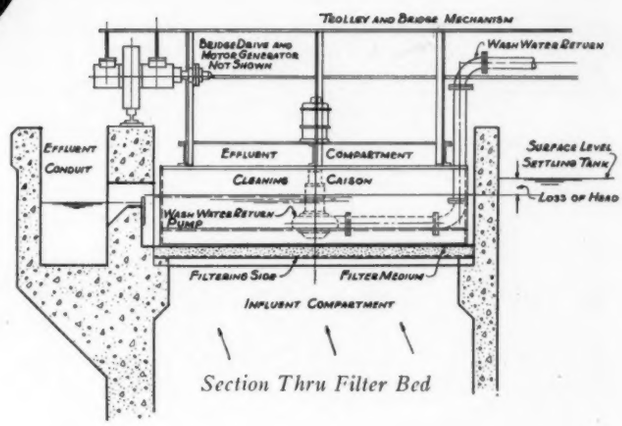
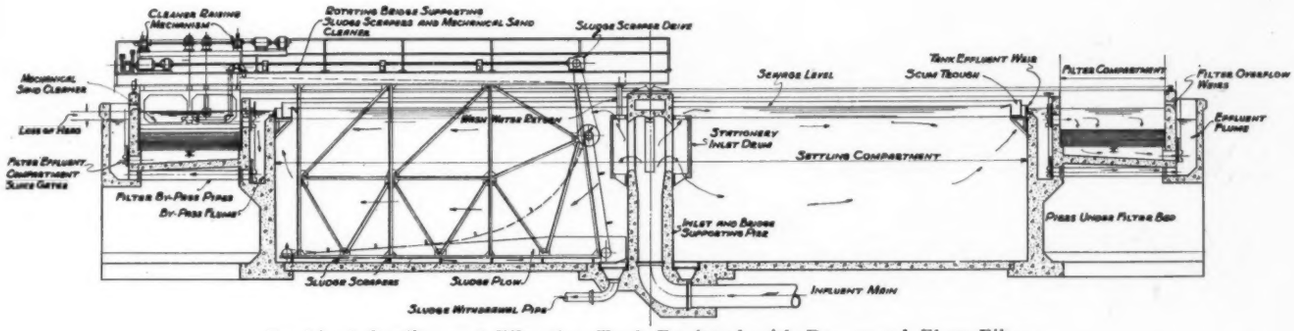
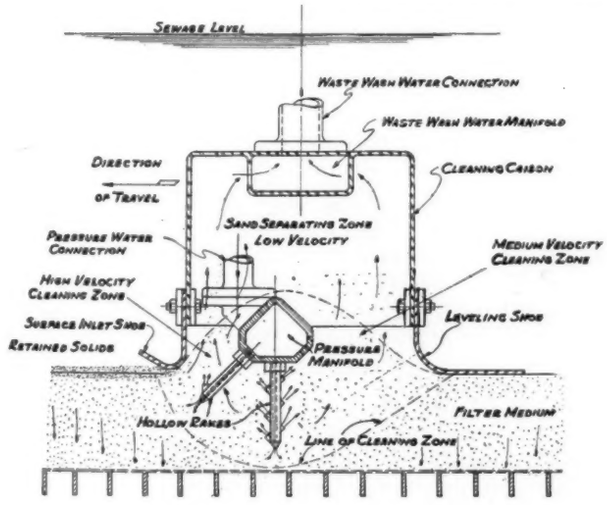
In Various Forms Are Available to Engineers Desiring to Design Modern Sewage Treatment Plants.



Section Thru Filter Bed



Combined Settling and Filtration Tank Equipped with Downward Flow Filter.



Section Thru Cleaner

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Vacuum Filters for Sewage and Sludge Filtration

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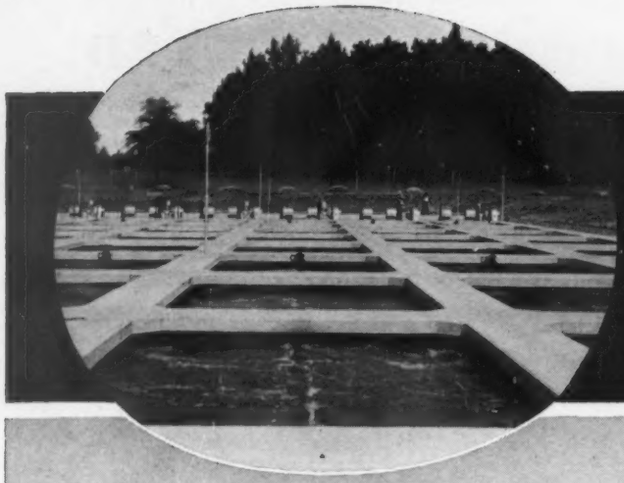

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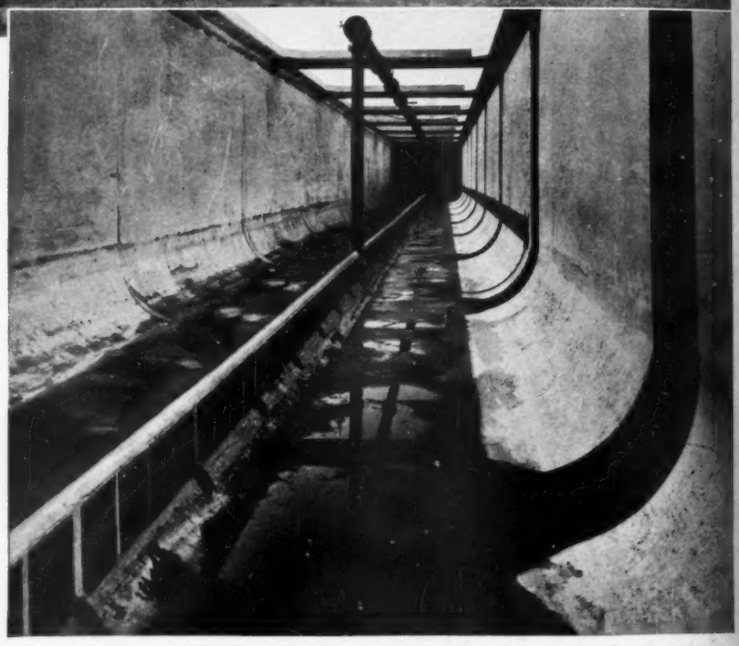
DIFFUSER PLATES



IN this interesting new plant at Durham, N. C., Aloxite Brand Diffuser Plates are used exclusively in the activated sludge aeration tanks—in the pre-aeration units for grease separation—in the sludge mixing tanks to prepare the sludge with lime for digestion—a complete installation.

In this plant Mr. William M. Piatt, the consulting engineer of Durham, has ably demonstrated the effectiveness and economy of secondary activated sludge treatment by diffused air.

Gas engines operated on the digestor gas drive generators which furnish more than sufficient power *to operate the entire plant.* The balance of the power aids in the pumping of water and in the lighting of city streets.

In the realization of an efficiency of this magnitude the use of the highest quality diffusers is most important.

ALOXITE BRAND DIFFUSER MEDIUMS
REG. U. S. PAT. OFF.

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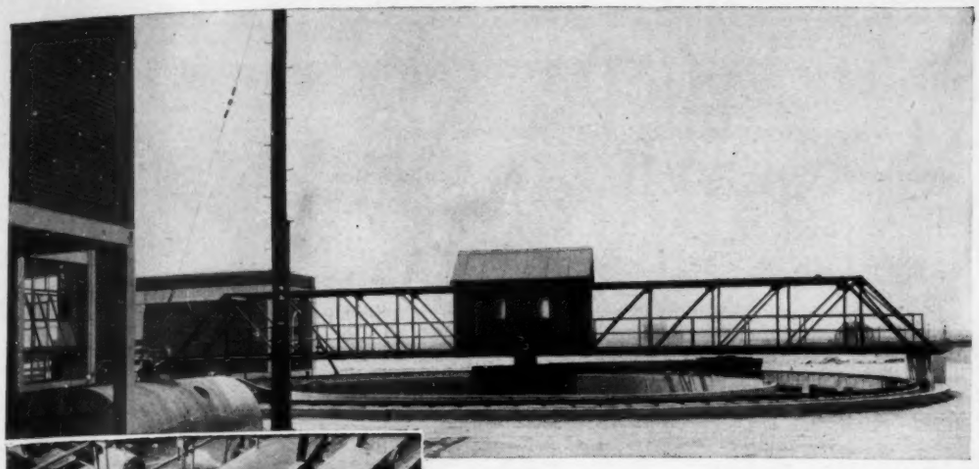
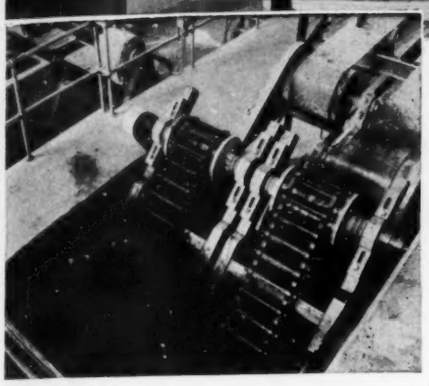
NIAGARA FALLS, N. Y.

CANADIAN CARBORUNDUM CO., LTD., NIAGARA FALLS, CANADA

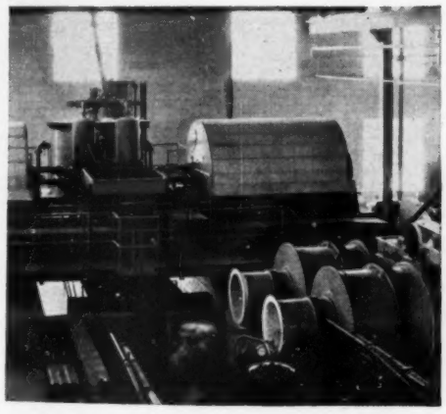
(Carborundum and Aloxite are registered trade-marks of The Carborundum Company)



The Laughlin Clarifier which combines settling and filtering through a bed of magnetite sand is cleaned automatically by a caisson containing a solenoid which travels over the magnetite bed.



This new chemical solution feeder, made by the Filtration Equipment Corp., is a device for storing, agitating and feeding ferric chloride in a very effective manner. The feed tank is lined with "U.S." Permobond, and specially designed flexible "U.S." Rubber belts carry "U.S." hard rubber containers which feed the acid as required. The drive is connected to the sewage Venturi meter which automatically controls the rate of feed.



Sludge is dried upon vacuum filters after being conditioned by lime and ferric chloride. Photo of sludge filters and auxiliaries.

New Jersey's Progressive New Sewage Disposal Plant at Perth Amboy

uses

"U. S." PERMOBOND

— for all ferric chloride handling —

When progressive Perth Amboy decided to build a sewage disposal plant, City Engineer Louis P. Booz, with a thought to future needs, chose the extremely flexible, economical chemical-mechanical treatment, using Laughlin Clarifiers and Magnetic Filters, made by the Filtration Equipment Corporation.

And for this very modern, very efficient plant they, in turn, chose the latest development in corrosion - resistant tank and pipe lining—"U.S." Permobond. At the Perth Amboy plant "U.S." Permobond is used to line the ferric chloride storage tanks and the measuring tanks, the units of the endless-chain ferric feeder and the lines that connect these units are made of "U.S." Permobond.

Equally successful are "U.S." Ferric Chloride Permobond installations in other sewage disposal plants such as Milwaukee, Indianapolis, Chicago, etc., etc. In fact, wherever it is being used this modern anti-corrodent is conclusively proving its superiority in both its adaptability and its length of service.

"U.S." Ferric Chloride Permobond can be applied to wood or metal . . . tanks, pipe and fittings.

"U.S." Engineers will welcome the opportunity to cooperate with you in solving your Ferric Chloride problems. A phone call or letter will bring a representative—without obligation to you.

United States Rubber Company

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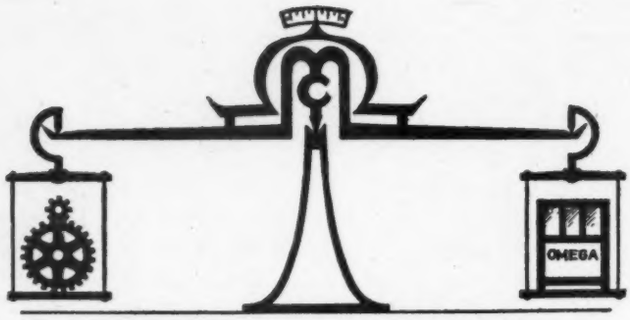
ENGINEERS
Specializing on Material
Metering & Feeding Problems



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of Omega Metering
and Feeding Machines

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602 Westport Ave. Kansas City, Mo.

OMEGA INTRODUCES

THE NEW GRAVIMETRIC FEEDER--Batch Type

For Measuring by Weight and Feeding All Kinds of Dry Material

(PATENTS ISSUED AND PENDING)

OUTSTANDING FEATURES: Control is entirely by weight. No calibrating. No guesswork. Set the graduated dial at the required rate of feed in pounds per hour, and the machine does the rest. The feed is continuous. An alarm notifies the operator of any variation from rate at which feeder is set to operate.

MATERIALS HANDLED: Any dry material (preferably passing a 1-inch screen) that can be fed from a hopper. (A complete line of Gravimetric Feeders for all kinds of liquids will soon be ready.)

CAPACITY: Standard sizes to meter and feed from 1 to 4,000 lbs. per hour, with hopper capacities from 500 to 10,000 lbs. Larger or smaller sizes built to order.

ACCURACY: Always within 1%. For special conditions the accuracy may be held within 1/10 of 1%.

RATE CONTROL: Manual or automatic proportional control as required. 100 rates of feed instantly available, a thousand if special conditions require.

METERING: Machine shows the exact total weight of material delivered therefrom.

OTHER OMEGA PRODUCTS: Volumetric Dry Feeders, two types, 3 sizes each.
Volumetric Liquid Feeders, several types and sizes.
Omega Lime Slakers, various sizes.
Laboratory Stirrers, Mechanical Agitators, etc.

OMEGA

The last word in Simplicity, Accuracy, Dependability.

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A White Elephant for many Foundries but an everyday job for **LYNCHBURG**

40" x 30" x 30" Flanged Ribbed Wye Bends

Its huge, odd shape would have made this SPECIAL CASTING a White Elephant for many foundries, but here at "Lynchburg" with more than half a century of successful experience in casting difficult special fittings it was but another everyday job. . . . Play Safe —write, wire or phone your specifications to "Lynchburg" for quick estimates.

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Seldom indeed are two pumping problems exactly alike—in municipal service, in industrial service or on some public project.

To plan or purchase pumping equipment on a price basis—or on experiences that do not take into account the newest and best-seasoned thought on pump design and manufacture, can be costly indeed.

In the handling of large quantities of water at low heads, for instance, there is a volume point below which centrifugal pumps cannot operate with full efficiency and flexibility. And it is at this point where F-M Propeller pumps take charge—handling large volumes of water in land irrigation, reclamation, city storm water systems, city water supply, excavation unwatering, and a host of other jobs with the full efficiency and economy desired.

Municipalities, engineers and those entrusted with the design or handling of water and other pumping projects are always welcome to take advantage of the years of Fairbanks-Morse experience and the resources of this manufacturing organization. F-M engineers will be glad to help you analyze and select the pump best suited to your needs. For full information address Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. 32 branches at your service throughout the United States.

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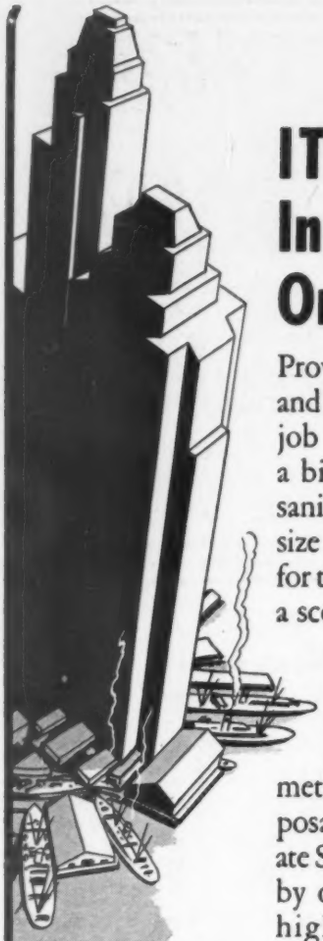

IT'S A BIG JOB In a Small Town Or a Metropolis

Providing pure water for homes and factories and doing a good job on municipal sanitation is a big responsibility for every sanitary engineer whatever the size of your community. It calls for the best in chemicals—and for a score of years we've supplied them, helping also to find the best method for using Bear Brand products, and ways to improve present methods. For most sewage disposal problems, the Intermediate Sewage Treatment developed by our engineers has proved highly satisfactory and it is simple and economical. Using Bear Brand Ferric Chloride in amounts as small as 1 grain per gallon, this treatment removes 85% to 95% of all suspended matter and reduces B.O.D. 70% to 80%. Installation and operation are simple.

And in water purification, Bear Brand Chlorine for sterilizing and disinfecting, Bear Brand Ferric Chloride for coagulation, and Bear Brand Chlorine-Ammonia treatment to eliminate objectionable odor and taste. We'll be glad to send detailed information.

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This one, inexpensive, portable machine can make your sludge output a profitable source of revenue, create a new industry and give profitable employment to several men.

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Maintenance men can tell you better than we can the advantages of a completely Crane-equipped plant, with instant interchangeability of many parts, constant, ever-ready supply, absolute uniformity, and the money-saving, worry-saving feature of one responsibility for every part of the plant piping.

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Design	Flanging
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There is a Crane Valve or fitting for every piping requirement

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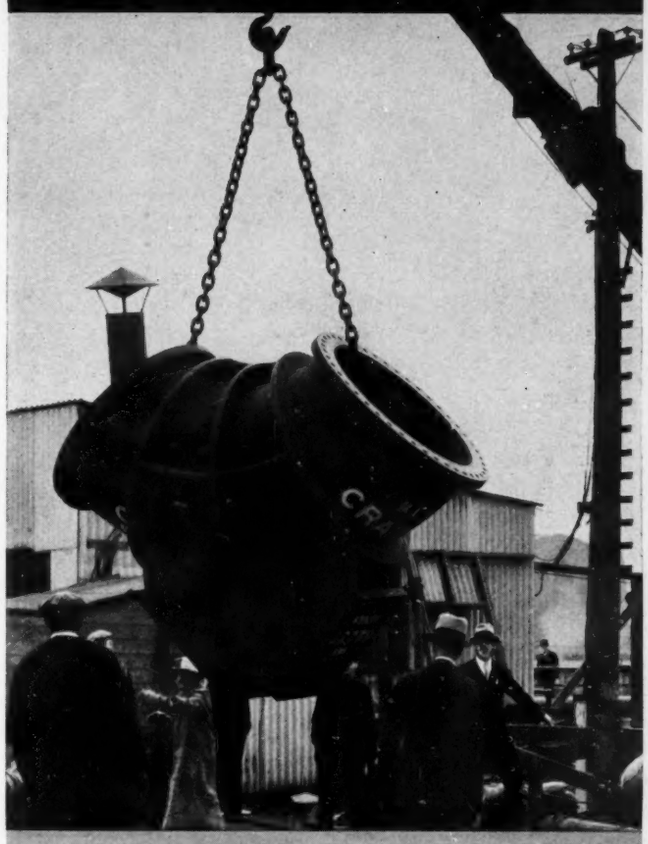

Crane 9-Ton Casting for Chicago Water Works

This Crane 48-inch Ferrosteel 90° base elbow made the headlines in Chicago papers on the day its nine-ton bulk was lowered 135 feet in the ground to its life-long job of supporting a 145,000-pound vertical pipe and a 100,000-pound column of water in the distribution lines leading from the new Cermak Pumping Station. Made in Crane Chicago Works. It is the largest single casting in Chicago's water distribution system.

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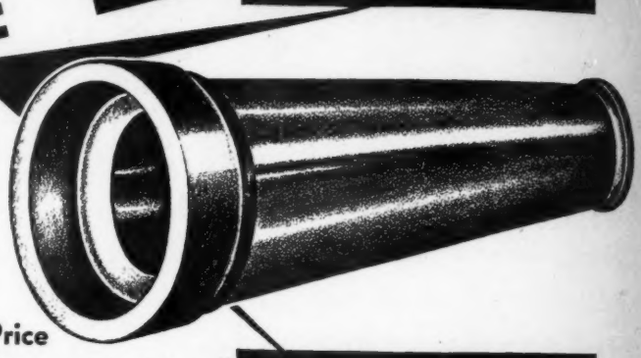
SAVE 1/2 on CAST IRON PIPE

36-INCH
BELL & SPIGOT
Class A
Standard 12 foot joints
Weight, 4250 lbs. per joint
Amount, 10,000 feet



This pipe was purchased new in 1917. It has been passed on by the Pittsburg Testing Laboratories and stands hydrostatic test. Complete with valves and fittings. Available in any quantity. Write for descriptive photographs and copy of Pittsburg Laboratories preliminary inspection report.

Price
FOB Kansas City, Mo.
$20 Per TON
Valves and Fittings Included

48-INCH
BELL & SPIGOT
Class A
Standard 12 foot joints
Weight, 8000 lbs. per joint
Amount, 7000 feet

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64 NORTH SECOND STREET KANSAS CITY, KANSAS

"Scru-Peller" Sludge Pump

Screw-Feed Centrifugal

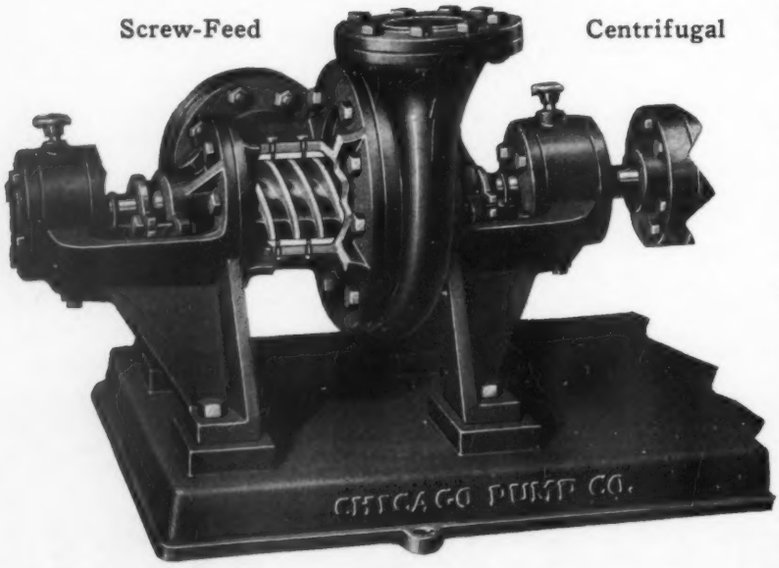

Fig. 1860—Chicago "Scru-Peller" Sludge Pump which was developed especially for handling Primary Sludge. The casing has been cut away in this picture to show the screw conveyor in the suction ahead of the impeller. The capacity can be varied from maximum of the pump all the way down to 1 G.P.M.

It Cuts As It Pumps Primary Sludge

Stellited cutting edges in the pump casing on both sides of the impeller cut up solids and prevent binding of the pump.

We have found that these stellited cutting edges are absolutely essential for successful operation of a centrifugal pump in handling Primary Sludge.

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Yes—we would like you to mention WATER WORKS AND SEWERAGE.

RALPH C. WYATT SAYS:

"We have been using Mathieson Chemicals for Twenty Years"

Ralph C. Wyatt, Superintendent of the City Water Works at Danville, Ky.

FEW people are charged with a greater responsibility than that of the water works man—the responsibility of guarding the health of an entire community against the ever-present hazard of water-borne disease. Knowing the importance of their job, it is no wonder that water works men appreciate dependable chemicals and dependable service.

That is why, of course, the City Water Works at Danville, Kentucky, has been so long a user of Mathieson Chemicals. Mr. Wyatt, the superintendent, says: "We have been using your products in our water works for about 20 years now and in that time have found both the products and your service to be entirely satisfactory."

"We use both chlorine and ammonia in the filtering plant and for the past two years have also been using HTH. This latter product is used for sterilizing all new pipe lines and construction and we keep a supply on hand as a protection against any breakdown of the chlorinators."

"In addition we use quite a bit of HTH in helping out people in the vicinity who have their own water supplies. We continually are called on to advise such persons about sterilizing their water or clearing up some contamination and we have found HTH particularly effective in this work."

A 72-page handbook on water purification by W. L. Savell is available free of charge to city officials and engineers. This book, "Hypo-Chlorination of Water" (Second Edition), contains nearly 50 illustrations and shows up-to-date methods and equipment. It tells you what to do under both ordinary and emergency conditions—and how to do it. Send for your copy today.

The MATHIESON ALKALI WORKS (Inc.)
60 East 42nd Street New York, N. Y.

Soda Ash . . . Liquid Chlorine . . . Bicarbonate of Soda . . . HTH and HTH-15 Caustic Soda . . . Bleaching Powder . . . Ammonia, Anhydrous and Aqua PH-Plus (Fused Alkali) . . . Solid Carbon Dioxide.

AN ANSWER TO THE QUESTION:
"WHAT IS THE MEANING OF pH?"

pH *And Its* Practical Application

By *Frank L. LaMotte*
William R. Kenny
Allen B. Reed

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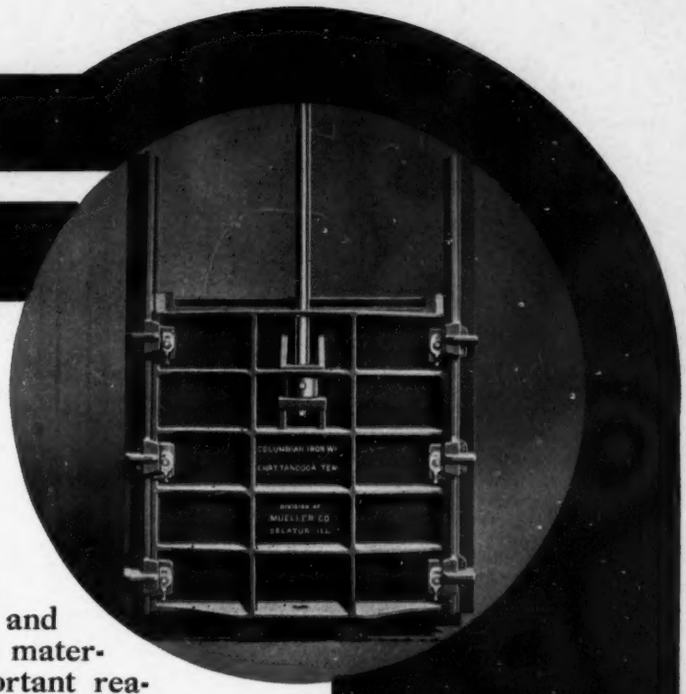

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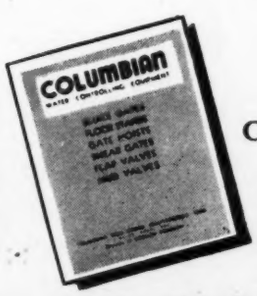

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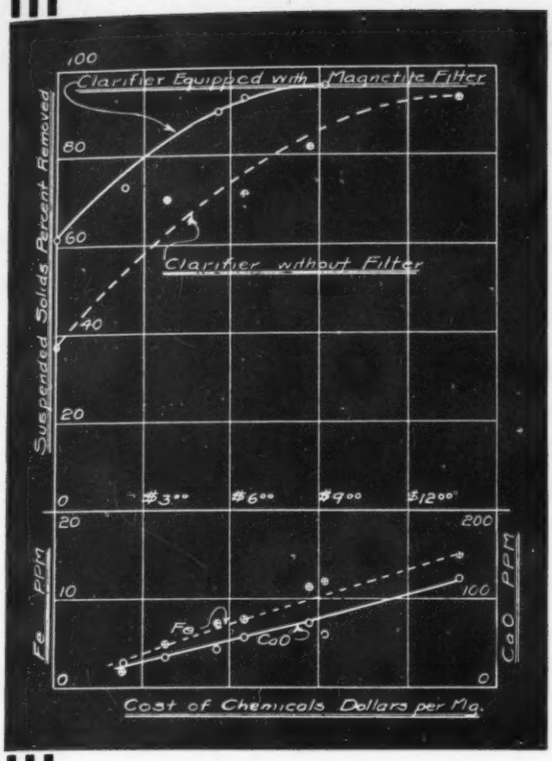

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(Stated in paper by Dr. Willem Rudolfs, Chief, New Jersey Sewage Experimental Station, Rutgers University, New Brunswick, N. J.: Mr. Joseph H. Brendlen, Research Engineer, Filtration Equipment Corporation, and Mr. William T. Carpenter, Chief Chemist, Department of Sanitation, City of New York, presented to American Chemical Society at the meeting in New York on April 23, 1935.)

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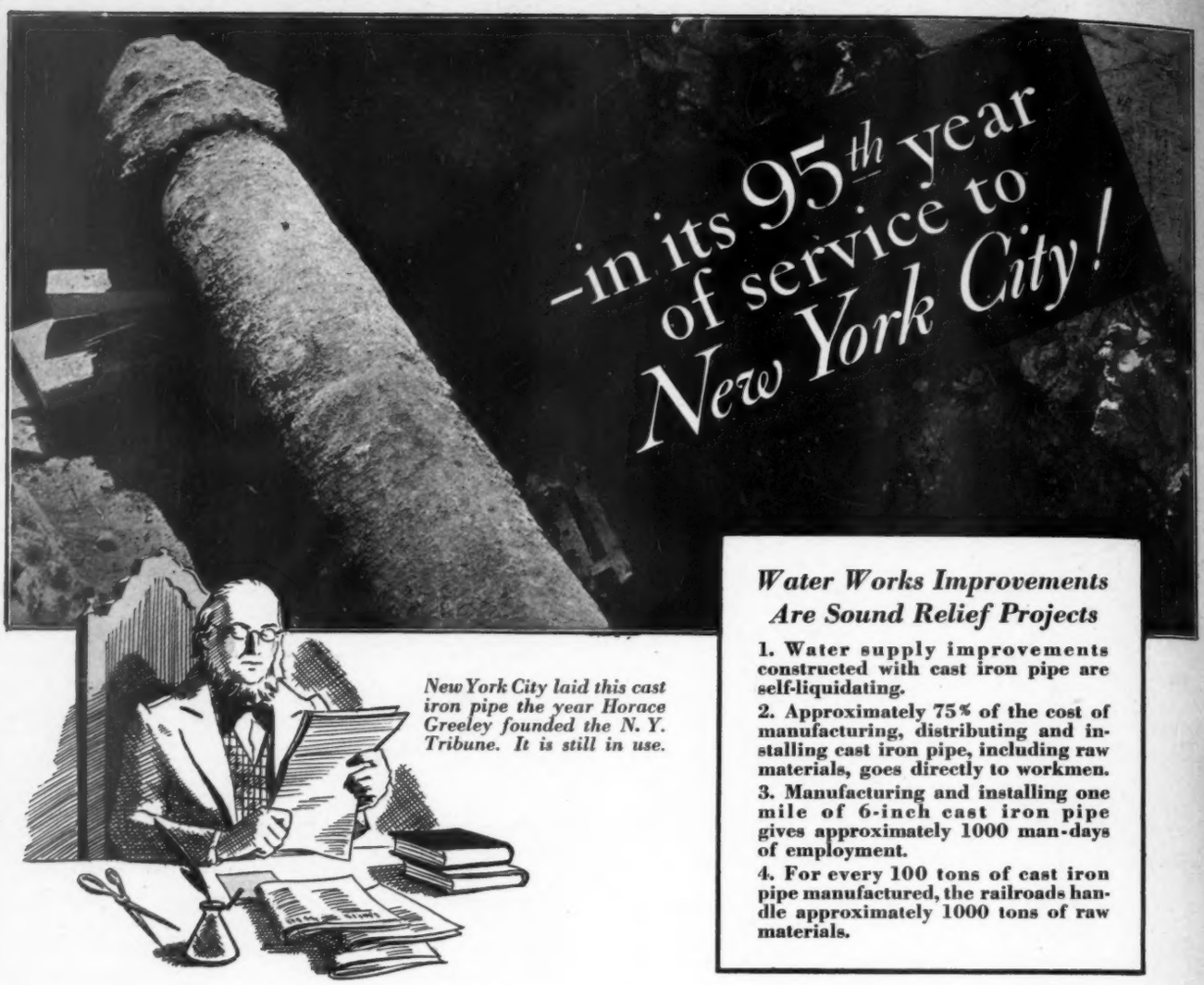

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UNDER a New York City pavement at the intersection of East Broadway and Montgomery Street lies a cast iron water main that was laid in 1841. A section exposed to cut in a valve, at the time the above photograph was taken, proved to be in excellent condition, good for generations to come. Some of New York's 4500 miles of cast iron mains are more than a century old.

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TRADEMARK REG.

WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. LXXXII AUGUST, 1935 NO. 8

Dearborn's Sewage Treatment Plant. The First Modern Plant to Adopt Chemical Treatment—1931—Now Ultra Modern Vacuum Dewatering and Incineration of Sludge.

SLUDGE INCINERATION AT DEARBORN

MARK B. OWEN
Superintendent, Public Works & Engineering, Dearborn, Michigan

The Author

SEVEN years ago, when the writer assumed the office of Superintendent of Public works and Engineering, a disturbing problem presented itself in the form of sludge disposal at the local sewage plants. While the matter appeared to be of gigantic proportions then, it was insignificant compared to the problem five years later.

In 1928 the volume of sewage treated at the East Side Plant averaged 5 m.g.d. An increase of population between 1920 and 1930 of better than 1900 per cent, together with the later addition of sewage from adjacent areas, has increased the volume to a daily average of over twenty million gallons. This total volume is divided as follows: 16.2 m.g.d. is treated at the East plant and 3.9 m.g.d. at the West plant.

The West Side plant was constructed about four years ago to treat sewage from the western portion of the city and, in addition, to receive and dispose of all sludge removed from the larger flow at the old East Side Plant. By this method of operating the two plants, the West Side plant became the point of disposal for all sludge produced from the total flow of sewage and only 3.9 m.g.d. of sewage proper. For several years a great deal of study has been devoted here to the problem of sludge disposal. The cost of land for drying beds and the type of development in adjacent areas were contributing factors to the selection of vacuum filters over sludge drying beds.

While it is well known that meat packers have a reputation of saving everything of the pig but the squeal I believe it is also generally known that the man behind the product for which Dearborn is famous—Mr. Henry Ford—wastes little. On the contrary the Ford industries make a great many things into useful articles from materials apt to be wasted in most other industries. The city officials therefore proceeded cautiously, if slowly, in the matter of determining what best disposition to make of its by-product of human waste treatment—sludge. When incineration of the sludge was ordered, all other known economical and sanitary methods had been considered thoroughly before discarding these in favor of sludge destruction rather than sludge recovery.

Upon the recommendation of the writer provisions had been made for the possible installation of an incinerator within the West Side plant four years ago when it was in the course of being built. It is a great satisfaction to me that we are able to report at this time upon the success of our sludge incinerator and state that in every respect, its operation and performance exceeds our early expectations. As far as we know we have taken the lead in utilizing incineration for sludge disposal by acquiring equipment of adequate capacity to handle all of the sludge produced at both our plants. Believing that we were pioneering, so to speak, we were particularly careful in the preparation of specifications and guarantees. While it seemed rather Utopian to expect a sludge burning furnace to produce less smoke and odor than that of the average home, we prepared specifications that came close to stipulating such results. Now that sludge incineration is an integral part of our disposal plant we can look at the outward appearance of our plant stack with pride and satisfaction because we do produce less smoke and odor than the chimney of the average home.

Incinerator Specifications

The incinerator specifications called for a furnace capable of burning to a clean ash 50 tons per day of sludge containing 65 per cent water and 35 per cent solids. The solids were to be considered as containing 65 per cent ash and 35 per cent combustibles on a dry basis. Combustibles were assumed to have a heating value of 10,000 B.t.u. per pound.

All bidders were required to submit a table of operating costs that were guaranteed to prove the total of all annual costs to the city for incinerating 50 tons of sludge daily as described above. This table known officially as Table No. 1 is shown later in the article. Table I was substantiated by accompanying heat balances showing fuel oil requirements. Evidence substantiating allowances for depreciation and maintenance was also submitted with the bids. In addition, certain guarantees were also required. The ones of general importance and interest are as follows:

> (A)—The Contractor shall guarantee that, at the unit prices stated, the costs submitted with his bid, in Table I, will be all the annual costs necessary, to reduce to a clean

ash, all the solids contained in the sewage sludge filter cake as described in the preface to Table I.

To determine whether this guarantee is fulfilled by the Contractor during the performance tests, hereinafter described, adjustment of the heat balances shall first be made for the B.t.u. content of the sludge cake supplied to the Contractor during the tests, after which the amount of fuel, power, labor, water and miscellaneous energy and for supplies shall be prorated in accordance with the tabulations of the same submitted in connection with the heat balances, to the conditions described in the preface to Table I. Unit prices stated in Table I shall then be applied and a similar table made up for comparison with Table I. Upon this basis the guarantee shall be binding for the entire range of conditions as set forth under the heading "Instructions to Bidders."

(B)—The Contractor shall guarantee that the fuel requirements, if any, as disclosed by the heat balances submitted by him in order to qualify, shall be all of the fuel required to complete the entire work of drying and incinerating the wet sludge (per hour of operation) when the unit is operating at a rate equivalent to 17.5 tons of moisture free solids per 24 hours. These fuel guarantees shall be binding within the entire range of analysis as set forth under the general heading "Instructions to Bidders."

(C)—The Contractor shall guarantee all materials and workmanship against defects or failures, for a period of one year. General wear and tear, and depreciation incidental to normal operation shall be excluded, as well as acts of Public enemies or conditions beyond human control.

(D)—The Contractor shall guarantee that under normal conditions of operation, material as described and set forth in the heat balances called for, shall be dried and burned in a satisfactory manner, and that no odor or smoke shall emanate from the equipment that is in any way due to the scorching of the material during any drying process or due to incomplete combustion during the burning processes. It is specifically understood that odors characteristic of undried sewage sludge cake shall not be included under the terms of this guarantee. During the first hour after starting up, smoke from fuel oil may be emitted provided it is not darker than Ringelman's Chart No. 1.

(E)—The Contractor shall fully guarantee his equipment to be capable of drying and incinerating to a clean ash 17.5 tons of solids of the moisture and ash content as herein described in each 24 hours.

(F)—The Contractor shall guarantee that all fly-ash shall be completely removed from the exhaust from his equipment.

Description of Equipment

On the basis of data submitted, the contract for furnishing the equipment was awarded to the Nichols Engineering and Research Corporation of New York. The unit furnished by the above company is called the Nichols-Herreshof Incinerator. The furnace, of the Herreshof type, was originally designed in 1885 for the roasting of pyrites in sulphuric acid plants, and since then many have been used in the fields of chemical, petroleum and metallurgical work. Apparently but little change was required in the unit to adapt it for sludge burning.

Briefly described, the incinerator is a "circular multiple hearth air-cooled" unit of refractory materials "enclosed in a protecting shell of steel." To the slowly rotating central shaft are attached rabble arms with teeth that convey the sludge across the hearts. The travel of sludge through the furnace may be more easily understood by referring to line drawing of the incinerator in cross-section that accompanies this article—See Plate 1. This drawing shows central openings on the first, third and fifth hearths; and peripheral openings (ports) on the second and fourth hearths. On the sixth hearth there is one single ash port. The central shaft and rabble arms are air cooled as the drawing indicates. A special feature which may be noticed is that the bottom edges of the rabble teeth are about three inches above the surface of the hearth. This allows for a constant bed of ash on the fire brick. The latter serves as a protection from free water that might cause spalling on the top hearth and avoids direct contact between burning materials and the lower hearths. We believe this ash insulation will add years to the life of the hearth brick.

Operation

Sludge cake from the Oliver vacuum filters is conveyed by belt to the feed hopper on the top of the incinerator. Between the filters and furnace is located a weighing device that automatically weighs, and records the weight of, the sludge cake. On the upper hearth the sludge is subjected to a stirring and turning motion by the action of the rabble arms. This action seems especially important, because it constantly exposes new sludge surfaces for drying. The upper hearth might be termed a drying hearth for here a large percentage of the moisture in the cake is driven off.

Under normal loading, sludge starts to burn on the second hearth. What may be called the lighter volatiles become ignited here and by the time the third hearth is reached all higher combustibles are burning vigorously. The fixed carbons start burning on this hearth also, and continue to burn until part way across the fifth hearth. The sixth hearth acts as a cooling chamber for the ash. By test, under certain conditions of lighter loads, vigorous burning will take place on the second hearth, and incineration will be completed on the fourth. When volumes in excess of the designed capacity have been delivered to the furnace, combustion may not start until the third hearth is reached and continue until the sixth. Ash is conveyed by bucket elevator to an outside bin and later hauled to a dump by a covered truck and trailer.

A No. 6 grade fuel oil is supplied to burners located on hearths 1, 2 and 4. A typical burner box is shown in Plate I and may also be seen on the exterior of the furnace as photographed in Plate 2. A blower located in the furnace pit furnishes air (either from within or without the building, as desired) for cooling the central shaft and rabble arms. While passing through these elements of the furnace the air reaches an average temperature of 450 F. It is then conveyed by an insulated duct to the "recuperator," or air preheater.

Two uses are made of the heat contained in the burned gases discharged by the incinerator: first it is passed through the recuperator for combustion air preheating, and then through an insulated duct to existing plant heating system boilers.

Recuperator—Pre-Heater

The gases from the top hearth of the incinerator flow through a refractory down-take, under a bridge wall and into the recuperator proper. Here the gases pass around the outside of "Carbofax" tubes 4 ft 4 in. long by 4¼ in. inside diameter, and thence to the duct that conveys them to the plant boilers. The tubes in the recuperator are arranged in three banks of 60 tubes each, with the banks superimposed one above the other. The cooling air from the central shaft of the incinerator is conducted from the top of the shaft through an insulated duct to a header covering the end of the top bank of preheater tubes, passes through the tubes and into another header, then through the next bank of tubes and similarly from there through the bottom tank. The construction and operation of the recuperator might be likened to a water tube boiler with the burned gases representing the heating gases in the boiler and the air the steam flow. Inasmuch as the recuperator is entirely of refractory construction it reacts as a combination of direct preheater and blast furnace stove. Thereby heat is absorbed or evolved from the refractories, as the burned gas temperature fluctuates up or down, tend-

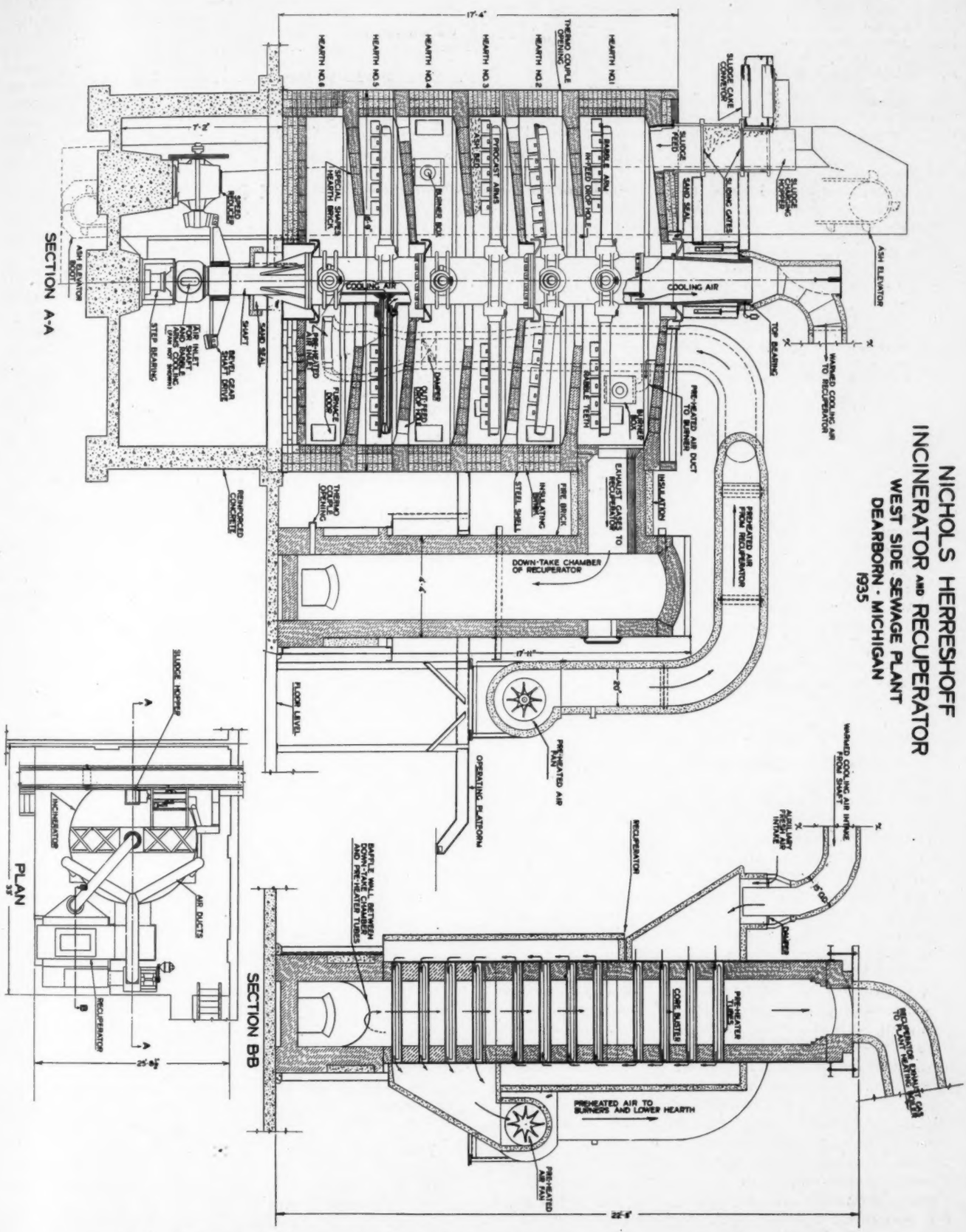

Plate I—Nichols-Herreshoff Sludge Incinerator and Heat Recuperator, Dearborn, Mich.

ing to make uniform the temperature of the preheated air.

From the bottom of the recuperator the preheated air is forced through insulated ducts to main combustion air inlets on the sixth (bottom) hearth and to auxiliary air inlets around each of the oil burners.

Auxiliary Equipment

All controls on the furnace are centralized at a single panel. Switches for all fans, oil pumps, and ash elevator are conveniently arranged for ease of operation. Also located on this panel are the temperature recorder, CO_2 recorder and sludge weight indicator and recorder.

Thermo-couples are located about the installation in the following places: One on each hearth for gas temperatures; one in the duct leaving the central shaft; one at entrance to fresh air inlet, of recuperator; one to measure temperature of preheated air entering furnace; one for exhaust gas from recuperator. Other auxiliary equipment includes a Pyrometer for controlling one motor operated oil burner; oil pre-heater; oil strainers; oil meters and thermometers; and oil pressure gauges.

The 90-Day Test

For the purpose of demonstrating that the equipment installed by the Contractor (Nichols Engineering and Research Corpn.) would meet the guarantees it was required that the incinerator be operated for a period of 90 days at the normal rate of sludge production; and, at any time during this test to operate at the designed rate of 50 tons per day for 48 consecutive hours.

Mr. Edmund C. Miller, Engineer in Charge of Sewage Treatment, in his reports, describes the test as follows:

"The 90-day test was begun at 8:00 a. m. February 25, 1935, and continued until 8:00 a. m. May 26, 1935. From the start of the test sludge was burned without interruption until March 28th, when cessation of incineration was necessary due to lack of sufficient sludge. Incineration was again started on April 1st, and continued until April 25th. However, operation during this period was not continuous, sludge being burned only about eight hours a day, the furnace being kept at a satisfactory temperature at other times by the use of fuel oil.

From a study of heat balances it was determined that the last was not a satisfactory method of operation. Hence from April 30th until the end of the test period sludge was stored until sufficient was on hand to operate the incinerator several days at or near the designed capacity rate of 50 tons per day. When the sludge on hand was consumed the equipment was shut down until another supply had accumulated. This was found to be the most economical mode of operation.

During the test period hourly records were carefully kept of the quantity of sludge incinerated, fuel oil and power consumed, all labor required, and temperatures at eleven separate points, as well as frequent observations as to smoke and odor conditions. Duplicate composite samples of sludge, made up of individual samples collected at half-hour intervals (at four points along the face of the vacuum filter) were analyzed daily. Determinations of total moisture, total solids, combustible solids, ash content, and B.t.u. values were made on the samples. The recorded results consist of the average of the results of the separate analyses of the samples examined in duplicate. All analytical work was performed in strict accordance with the terms of the contract.

The required full capacity test was arranged and begun at 8:00 a. m. March 8th and continued without interruption, except for 7 ten minute intervals (6 of

Table I.—Contractor's Table of Annual Costs (as Supplied)

500 Man hours common labor @ .60 dollars	$ 300.00
8,760 Man hours skilled labor @ .80 dollars	7,008.00
191,000 Gallons fuel oil @ .04 dollars	8,404.00
131,000 Kwh. electric power @ .01 dollars	1,310.00
6,000 Cubic feet city water @ .85 per M	5.10
Miscellaneous supplies	125.00
Total operating charge	$17,152.10
Amortization @ 5.8 per cent of bid price	$ 3,248.00
Depreciation @ 4.2 " " " " "	2,352.00
Maintenance @ 2.0 " " " " "	1,120.00
Total fixed charges	$ 6,720.00
Operating charges	$17,152.10
Fixed charges	6,720.00
Total	$23,872.10

Table II.—Summary of Test Data

	48-hr. test	90-day test
Actual hours of operation	48	1,255
Sludge incinerated (tons)	118.61	2,258
Dry solids incinerated (tons)	39.64	755
Average moisture content of sludge cake (per cent)	66.56	66.57
Average combustible solids (per cent)	46.46	50.29
Average B.t.u./lb. combustibles	10,672	10,832
Fuel oil used for incineration (gals.)	226.6	5,101
Electric power (kwh.)	475	10,325
City water (cu. ft.)	94.2	4,239
Labor (manhours)	26.5	661

Table III.—Forty-Eight Hour Test Data Prorated to Conditions of Table I

1,095 Hours common labor @ .60	$ 657.00
3,741 Hours skilled labor @ .80	2,992.80
80,273 Gals. fuel oil @ .04	3,210.92
80,280 Kwh. electric power @ .01	802.80
17,000 Cu. ft. city water	14.45
Supplies	30.09
Total operation	$7,978.06
Amortization @ 5.8 per cent of bid price	$3,248.00
Depreciation @ 4.2 " " " " "	2,352.00
Maintenance @ 2.0 " " " " "	1,120.00
Total fixed charges	$6,720.00
Operating charges	$7,978.06
Fixed charges	6,720.00
Total cost	$14,698.06
Total cost from Table I	$23,872.10
Total cost from above Table	14,698.06
Difference	$9,174.04

Table IV.—Ninety Day Test Prorated to Conditions of Table I

1,314 Hours common labor @ .60	$ 788.40
3,394.5 Hours skilled labor @ .80	2,715.60
103,800 Gal. fuel oil @ .04	4,152.00
79,509 Kwh. electric power @ .01	795.09
17,000 Cu. ft. water @ .85/1000	14.45
Supplies	30.09
Total operation cost	$8,495.63
Amortization @ 5.8 per cent of bid price	$3,248.00
Depreciation @ 4.2 " " " " "	2,352.00
Maintenance @ 2.0 " " " " "	1,120.00
Total fixed charges	$6,720.00
Operating charges	$8,495.63
Fixed charges	6,720.00
Total cost	$15,215.63
Total cost from Table I	$23,872.10
Total cost from above Table	15,215.63
Difference	$8,656.47

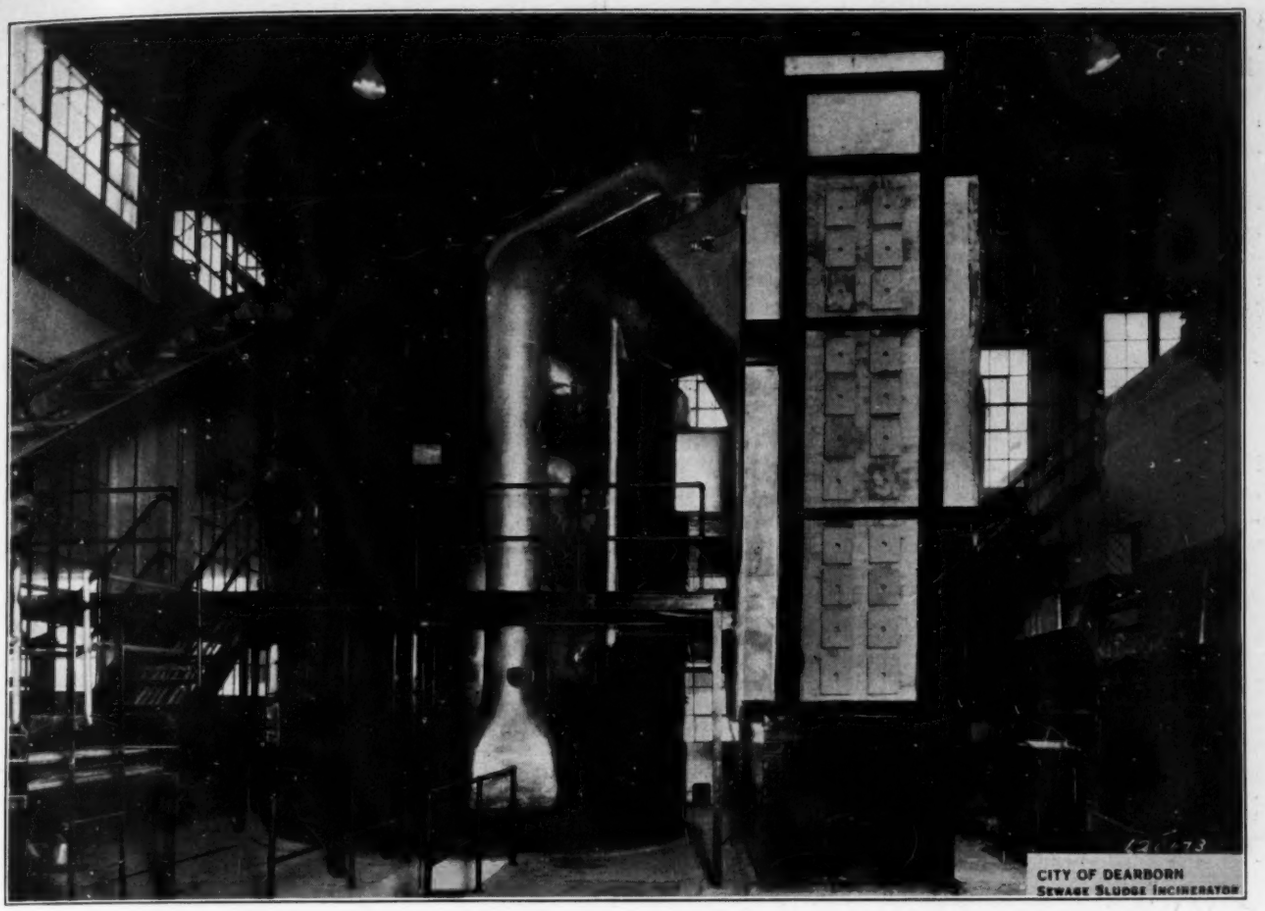

Plate II—Dearborn's Sewage Sludge Incinerator (Left) and Pre-Heater (Right) (Nichols-Herreshoff Incinerator) Sludge Coke Conveyor Belt Shown on Left.

which were for checking the sludge weighing mechanism) until 8:00 a. m. March 10th. During this period samples of sludge were collected at 15 minute intervals and analyses made every four hours. Otherwise the conduct of the test and the date collected were same as for the 90-day test."

Quoting further from Mr. Miller's reports—"The contract specifies the method to be used in prorating costs obtaining during the tests for comparison with the costs guaranteed by the Contractor and set forth in the contract as Table I. The costs have been prorated as required and are given in Tables III and IV. Table III is the proration of the costs obtaining during the 48 hour test and Table IV the proration of the same for the 90-day test. The tables also give the difference in costs as compared with the guaranteed figures. These differences represent a saving to the city, but should not be interpreted as meaning the actual savings, inasmuch as they are prorated values used to give a comparison under certain standard conditions.

Table V.—Expansion of Actual Incineration Costs During Ninety Day Test Period to Annual Basis Together With Anticipated Costs Upon Basis of Heat Balances.

	Quantities	
	Allowed	Actual
Labor, common (man hours)	500	1,314
Labor, skilled (man hours)	8,750	3,395
Fuel oil (gal.)	79,430	43,084
Electric power (kwh.)	143,968	87,379
Water (cu. ft.)	6,000	17,000
	Cost	
	Allowed	Actual
Labor, common	$ 300.00	$ 788.40
Labor, skilled	7,008.00	2,715.60
Fuel oil	3,177.20	1,723.36
Electric power	1,439.68	873.39
Water	5.10	14.45
Supplies	125.00	30.09
Total operating costs	$12,054.98	$6,145.29
	Allowed	Actual
Operating costs	$12,054.98	$6,145.29
Fixed costs	6,720.00	6,720.00
Total annual costs	$18,774.98	$12,865.29
Difference or Saving	$5,909.69	

In order to give a more accurate picture of what the actual savings to the city will amount to as compared with the anticipated costs, Table V has been prepared. The costs entitled 'Actual Costs' have been arrived at by expanding the actual costs during the test period to an annual basis, assuming full capacity continuous operation. The figures 'Allowed Costs' have been computed from the heat balances upon the same basis as Table I of the contract, using, of course, the actual values of moisture, content, combustible content, heating value, etc., that occurred during the 90-day test."

We have on numerous occasions been questioned as to the variations in operating conditions, temperatures, costs, etc., as compared with the variations in sludge quantities and characteristics. To answer such questions the following tabulations and excerpts, taken from daily operating records, are presented.

For each 24-hour operating period of the test a summary of data was prepared. Table VI was prepared from the reports of various days of the period.

The data in Table VII was compiled from the operating records of March 2, 1935. At 8 A. M. of this day 2 oil burners were in operation burning 6 gals of

oil per hour. At 11:30 A. M. one burner was turned off. The sludge feed fell off at 1:30 P. M. due to a shut-down of the sludge elevator for repairs. Between 2 and 3 P. M. the sludge feed increased about 1,000 lbs. per hour, but caused no appreciable change in temperatures.

The operator on duty during the afternoon shift on March 2nd made the following entry in the log: "Temperature on No. 3 hearth began dropping off a bit at 5:30. It looks as though the sludge is practically burned out on No. 2 and finishing the burning with small yellow flame on about 1/5th of No. 3 hearth and a violet blue flame burns on the other 4/5ths of hearth No. 3. No burning on No. 4 hearth—just a red glow across the whole hearth with very little red ash on No. 5 and none on No. 6."

"At 8:00 P. M. the $FeCl_3$ feed for sludge conditioning was reduced which caused a dropping off of sludge feed. About 1:30 A. M. the vacuum filter was speeded up and as a result the sludge volume increased. Increased volumes of sludge were burned after 4 A. M. without further adjustments of furnace and without any great change in temperatures."

The log shows that no visible smoke was emanating from the stack at any time during this day as a result of minor operating difficulties and a varying sludge feed.

Table VIII contains data from the operating records of May 4, 1935. The furnace had already operated 88 hours continuous, and *without fuel oil.* The weights of sludge burned on the days preceding this period are shown in Table VI.

The operator in charge of the morning shift of May 4th made the following observations and noted them in the log book:

"Furnace running without any burner. Volatile combustibles burning with long yellow flame on No. 2 hearth with a small amount of fixed carbon starting to burn near the drop holes of hearth No. 2. On hearth No. 3 the volatile combustibles were burning under the drop holes of hearth No. 2, and across the rest of the hearth the fixed combustibles were burning with a yellow and purple-blue flame. Hearth No. 4 had yellow-

Table VI.—24 Hour Operating Results by Days

	March								May				
	2	3	4	10	14	15	20	28	1	2	3	4	5
Filter cake burned (tons)	54.72	55.74	56.31	50.45	40.83	39.78	32.91	10.71	48.18	52.59	44.63	46.34	49.11
Dry solids burned (tons)	18.61	19.14	19.21	17.35	14.57	13.57	11.21	3.46	16.63	17.17	15.67	16.73	14.77
Filter cake moisture (per cent)	65.99	65.67	65.89	65.61	64.31	65.88	65.94	67.70	65.49	67.35	64.88	63.90	69.92
Filter cake solids (per cent)	34.01	34.33	34.11	34.39	35.69	34.12	34.06	32.30	34.51	32.65	35.12	36.10	30.08
Combustibles in solids (per cent)	47.00	46.43	47.45	49.73	49.59	49.75	50.07	47.88	54.62	53.75	57.23	56.46	52.56
Ash in solids (per cent)	53.00	53.57	52.55	50.27	50.41	50.25	49.93	52.12	45.38	46.25	42.77	43.54	47.44
B.t.u./lb. dry solids in cake	5,299	5,327	5,068	4,806	5,538	5,570	5,397	4,544	4,879	5,967	6,226	6,200	6,216
B.t.u./lb. combustibles in cake	11,274	11,473	10,681	9,664	11,168	11,196	10,780	9,480	10,763	11,101	10,879	10,981	11,826
Fuel oil used for incineration (gals)* Total	68.3	57.2	56.5	106.1	....	....	....	76.3	....	....	....	....	29
Per ton sludge cake	1.25	1.03	1.00	2.10	....	....	....	7.11	....	....	....	....	0.59
Allowed by Spec./ton	2.11	0.89	3.55	6.12	0.70	2.30	4.73	12.25	....	0.74	....	....	2.32
Electricity used (kwh.)	226	218.5	212	230.5	150	149.5	158	74	171	171	164	158	188
Total labor (hours)	16	12.5	15	15	9.5	11.25	9.5	8	10	9	10	10	13
Actual hours of operating	23.53	23.45	23.62	23.50	23.67	23.5	23.5	8.25	23.67	23.67	23.67	23.83	23.67
Total Cost													
Allowed by Specification	$28.74	26.16	32.17	36.34	23.83	27.24	28.55	26.36	23.83	25.44	23.73	23.86	28.26
Actual	$17.63	13.81	15.42	17.39	9.04	10.39	9.02	9.63	9.45	8.75	9.68	9.62	12.68
Cost per ton sludge cake**	$ 0.32	0.25	0.27	0.34	0.22	0.26	0.27	0.96	0.20	0.17	0.22	0.21	0.26

*From 12 noon, April 30th, to 12 noon, May 5th, a total of 240.59 tons of sludge was incinerated without the use of any fuel oil.
**For amortization, depreciation and maintenance, add 40c.

Table VII.—Operating Records of March 2, 1935

Time	Sludge Feed (lbs.)	Oil Burned (gals.)	Exhaust Gas From Furnace	Temperatures (Degrees F.) Hearths No. 2	No. 3	No. 4	No. 5	No. 6	Exhaust of Recuperator	Preheated Air to Furnace
8–9 a. m.	3,660	6	1,160	1,600	1,650	1,060	800	550	850	630
10	3,530	5	1,170	1,630	1,670	1,060	790	560	890	690
11	4,010	6	1,060	1,510	1,660	1,020	770	560	880	710
12	4,080	5	1,240	1,700	1,720	1,200	820	580	950	760
1 p. m.	3,940	3	1,130	1,600	1,710	1,110	820	580	920	760
2	3,750	2	1,030	1,410	1,570	1,110	840	570	880	730
3	4,710	3	1,120	1,590	1,700	1,190	900	590	900	730
4	4,920	3	1,130	1,610	1,700	1,220	940	600	930	740
5	4,220	4	1,130	1,630	1,710	1,220	940	600	910	730
6	4,300	3	1,110	1,610	1,710	1,160	870	590	910	730
7	5,300	3	1,080	1,580	1,670	1,250	980	600	890	720
8	5,100	3	1,100	1,650	1,730	1,260	980	610	890	710
9	4,700	2	1,140	1,680	1,770	1,240	940	600	930	720
10	4,400	2	1,150	1,700	1,770	1,240	900	600	930	740
11	4,550	3	1,150	1,720	1,750	1,240	940	600	930	740
12	4,550	2	1,170	1,720	1,770	1,240	930	600	940	740
1 a. m.	4,070	2	1,040	1,120	1,400	1,130	800	580	900	740
2	5,210	2	1,120	1,640	1,730	1,310	1,070	650	910	720
3	4,820	3	1,170	1,700	1,780	1,240	930	610	940	740
4	4,200	2	1,210	1,700	1,720	1,150	860	590	940	750
5	5,330	2	1,140	1,690	1,770	1,240	940	590	940	740
6	5,380	3	1,180	1,690	1,760	1,250	950	590	950	740
7	5,260	2	1,130	1,680	1,750	1,240	940	590	930	740
7–8	5,850	2	1,100	1,630	1,700	1,280	1,060	610	920	730
Average	4,577	3	1,133	1,616	1,707	1,194	905	592	915	728

Table VIII.—Operating Records—May, 4, 1935

Time	Sludge Feed (lbs.)	Oil Burned (gals.)	Temperatures (Degrees F.) Exhaust Gas of Furnace	Hearths No. 2	No. 3	No. 4	No. 5	No. 6	Exhaust of Recuperator	Preheated Air to Furnace
8-9 a. m.	3,480	0	1,280	1,720	1,660	1,020	730	570	1,020	900
10	3,300	0	1,210	1,660	1,590	980	720	570	1,000	880
11	3,630	0	1,240	1,650	1,580	1,020	730	580	990	880
12	3,910	0	1,210	1,700	1,670	1,020	730	590	990	880
1 p. m.	3,910	0	1,190	1,770	1,700	1,050	730	610	990	870
2	3,940	0	1,260	1,760	1,710	1,070	760	600	1,030	880
3	3,590	0	1,260	1,770	1,750	1,070	760	590	1,050	900
4	4,160	0	1,390	1,750	1,660	1,010	720	560	1,080	940
5	3,510	0	1,170	1,670	1,770	1,120	770	510	1,010	930
6	3,840	0	1,320	1,740	1,680	1,120	780	520	1,060	910
7	3,340	0	1,160	1,670	1,770	1,080	730	500	990	920
8	4,370	0	1,280	1,450	1,540	1,040	740	520	960	890
9	3,280	0	1,150	1,740	1,770	1,130	780	540	960	870
10	5,030	0	1,270	1,430	1,440	950	680	500	950	890
11	4,010	0	1,100	1,530	1,630	1,220	1,020	700	940	830
12	3,470	0	1,380	1,720	1,600	1,100	840	640	1,030	840
1 a. m.	3,900	0	1,200	1,620	1,690	1,060	760	560	990	880
2	4,200	0	1,230	1,720	1,690	1,040	730	510	1,000	880
3	4,050	0	1,200	1,720	1,770	1,060	730	500	980	890
4	3,600	0	1,230	1,740	1,770	1,060	720	490	990	890
5	4,050	0	1,230	1,740	1,670	1,000	700	470	1,010	910
6	4,350	0	1,200	1,740	1,770	1,050	700	470	990	900
7	3,900	0	1,120	1,680	1,770	1,030	730	470	950	880
8	4,090	0	1,330	1,770	1,720	1,080	720	470	1,020	880
Average	3,871	0	1,234	1,700	1,682	1,058	750	543	1,003	888

blue-purple short flames clear across the hearth. Hearth No. 5 was dark as was hearth No. 6, incineration having been completed on hearth No. 4."

Summary and Conclusion

The incinerator has now been in operation about five months. The data and information given in Tables VII and VIII are typical of regular daily operation. The costs to date indicate that incineration for us is about 35 cents per ton cheaper than disposal of sludge in free dumps.

The problem of ash disposal is simple. Analyses made on catch samples shows less than 1½ per cent of organic matter. The sludge burns to a very fine ash. Approximately, the ash runs about 15 per cent by weight, of the sludge cake. Hence we conclude that disposal of our sludge by incineration is, at once, simple, clean, and economical.

Plate III—Dearborn's Sludge Incinerator and Vacuum Filter Arrangement—Control Board Is in Left Center. Sludge Cake Recording Scales Are Beyond the Ohio Filters

The installation of the incinerator was a part of the sewage plant improvements financed through the P.W.A. Specifications were drawn by Edmund C. Miller, Engineer in Charges of Sewage Treatment, under the supervision of the writer. Construction and tests were supervised by the same personnel. The contract costs of incinerator and auxiliary equipment was $56,000.

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Central States Section, A. W. W. A., Planning Exceptional Convention

The Central States Section of the A.W.W.A. program for its Annual Convention, to be held in Pittsburgh, Pa., at the Fort Pitt Hotel, indicates that an exceptional meeting has been planned.

Amongst the headliners, appears Professor Lewis P. Carpenter showing moving pictures and holding an "Open Forum" on Water Works Practices. Gale Dixon describes "Dam Experimentation (with Models Built to Scale) for Erosion Control."

Other subjects to be discussed are: "Control of Electrically Operated Pumping Stations by Modern Methods," by S. A. Canariis, of Pittsburgh; "Experiences with Water Treatment on the Monongahela River," by F. W. Bowson; "The Application of Electric Rates to Water Rates Making," by Nathan S. Jacobs; "Chlorine Disinfection," by Prof. W. L. Mallman of Lansing, Mich.; "Water Works Experiences as a Health Official," by H. E. Moses.

The recently growing appreciation of the meaning of "Public Relations" in the water works field is another headliner topic to be picturized through the courtesy of the Indianapolis Water Co. Miller Hamilton will unreel running comments and the Indianapolis movie "Behind the Water Front" in which in a popularized way John Q. Public learns how the water works prepares for and goes into "action" to protect his health and property and that of his family and his neighbors.

Entertainment scheduled lists a County Club Golf Tournament and Dinner Dance with excursions et al for the ladies, in addition.

WILLIAM MULHOLLAND
Hydraulic Engineer—1855-1935

WILLIAM MULHOLLAND, veteran hydraulic engineer of Los Angeles, Calif., died on July 22nd at his home only a few weeks in advance of his 80th birthday.

Closing a colorful career as a self-made engineer, he died seven years after resigning from active duty as Chief Engineer and General Manager of the Los Angeles Bureau of Water Works and Supply. He won world-wide recognition as the builder of the 250 mile long Los Angeles Aqueduct which brought from the Owens River, through the desert, the life giving water requirement of that phenomenally growing metropolis in arid Southern California—Los Angeles.

Born an Irishman, on September 11, 1855, in Belfast, he sailed before the mast, landed in California as a young man, liked it and remained. In 1878 he was given a job as a zanjero (in English, an irrigation ditch-tender) with the old City Water Company. He studied hydraulics and engineering text books in his ditch-tender's shack, received early recognition for his ability, and eight years later (1886) was made General Superintendent of the company. In 1902 when the city bought the company, Superintendent Mulholland in his expressive way said, "They bought the works—and me with it."

Bill Mulholland, as he was familiarly known to the West, grew up with the city and its water supply system (then serving but 3,000 people) to the great metropolitan system of today with more than 300,000 separate services. It was primarily through his far sighted advanced planning that the great aqueduct system was completed in time to prevent a serious water shortage at a critical period in the city's meteoric increase in population. Probably it is more accurate to say that Los Angeles grew with Mulholland; for the city could grow only in so far as its water supply grew ahead of it—and, in the arid West as nowhere else, "Water *is* King."

On a secretly made fifty day trip, by buckboard and mule team, he went to personally survey every possible source of water supply beyond the intervening desert country. Conceiving the idea, and then carefully weighing its practictability, he returned to "sell" to Los Angeles citizens the proposed gigantic undertaking of bringing 250 miles to the city the waters of Owen's River. Only by dogged perseverance and many public speakings did he win over a serious opposition, and in 1905 he and his backers succeeded in getting the first of the needed bond issues voted. In 1907 the balance of the estimated requirement of $24,500,000 was voted and in 1913 the project, on which work started in 1908, was completed at a cost just $40,000 less than the Mulholland estimates. When, again he was called on to speak—this time at the ceremonies marking the turning in of the Owen's River waters to the city—his brief comments, in referring to the gush of water that he had eight years before started out after, were characteristic of the man. He merely said, *"There it is—Take it."*

In 1923 once more Mr. Mulholland started in search of additional water. After several surveys he recommended an aqueduct from the Colorado River to the city, the data on which was turned over by him to the subsequently formed Metropolitan Water District Commission in 1928. That same year he resigned from active duty after 50 years of continuous service, to be succeeded as Chief Engineer and General Manager of the Bureau of Water Works and Supply, by his able assistant, H. A. Van Norman.

In recognition of his accomplishments the University of California in 1914 conferred on Mr. Mulholland the honorary degree of L.L.D. He was a member of the American Society of Civil Engineers and a member of several other professional societies. He was made an honorary member of the American Water Works Association, and of the engineering fraternity, Tau Beta Pi. He was a member also of several of the most recognized clubs in California.

As a practical engineer, Mulholland knew how to do things—get them done, and done on scheduled time. Human, he made his mistakes; but, these were eclipsed by his attainments and monumental successes. Los Angeles owes its very "life blood", that flows through her underground "arteries", to William Mulholland.

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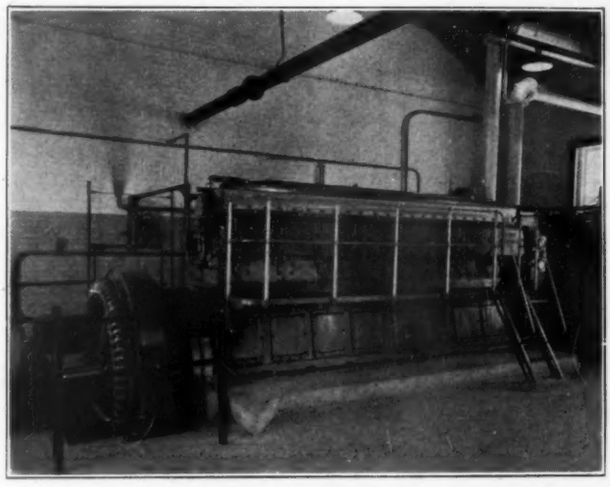
DIESEL ENGINE CUTS PUMPING COSTS 70 PER CENT AT GAINESVILLE, TEXAS

Originally, Gainesville, Tex., used gas fired boilers and steam-engine driven compressors for lifting water. It cost the city three cents per thousand gallons to put the water into the system. Later, when an oil-well came in near Gainesville, the boilers were converted to use oil as fuel. This reduced the cost of putting water into the stand-pipe and system to two cents per thousand gallons.

In January of this year an eight-cyclinder, Type-JT Cooper-Bessemer Diesel Engine (365 H.P. at 327 r.p.m.) was installed. The engine is direct connected

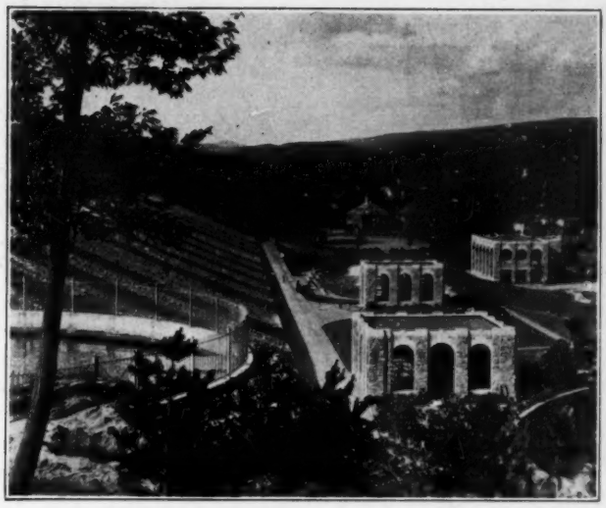


New Eight Cylinder Diesel—Pumping Station, Gainesville, Texas

to an electric generator—(312 KVA 250 K.W. 2400-volt, 3-phase, 60 cycle) with a 10 K.W. exciter. With the new engine, the cost of pumping has dropped to six mills per thousand gallons. This serving of 1.4 cents per thousand gallons represents a reduction of 70 per cent in the cost of pumping.

In order to lower water costs by purchasing modern equipment, and ultimately to also establish a municipal power plant, a plan was developed at Gainesville in 1934, wherein surplus revenue from the Water Department is transferred to a special fund for water-works improvements. By January 1, 1935, a sufficient fund was available to buy the new Diesel engine. After this engine was purchased, the city ran a power distribution line uptown to light the "White Way," to serve City Hall, the Fire Department, the Parks, and also some of the city's street lights.

With the increase in net water works earnings, which are resulting from the present Diesel engine, an adequate fund is anticipated to buy another Diesel of 750 H.P. by the end of the year.



Wanaque Dam and Headworks of the North Jersey District Water Supply Commission

WATER WORKS FINANCES—PAST, PRESENT AND FUTURE

By CHARLES H. CAPEN, JR.
Civil and Sanitary Engineer, West Orange, N. J.

PROBABLY at no time in the history of this country has the average citizen been so politically minded as in recent times. The reason is clear and simple, namely, his pocketbook has been affected. While incomes were shrinking everywhere, it was but natural that the taxpayer should look for a reduction in taxes and hence in municipal expenditures. Although water works utilities have been generally self-sustaining, they have come in for more than their fair share of criticism. Water rates have been attacked, salaries have been reduced and even then the clamor has been for further reductions. In the case of privately owned systems, it has been the rates that have been under fire. With municipally owned systems it has been mainly salaries. The writer has had occasion to study this situation in some detail and to draw definite conclusions as to what extent this attitude has been justified. The study necessarily involved both private and public supplies and permitted a comparison of the two. However, in order to supply the ground work on which the comparison and conclusions are based, it will be necessary to go back and review the circumstances leading up to the recent situation.

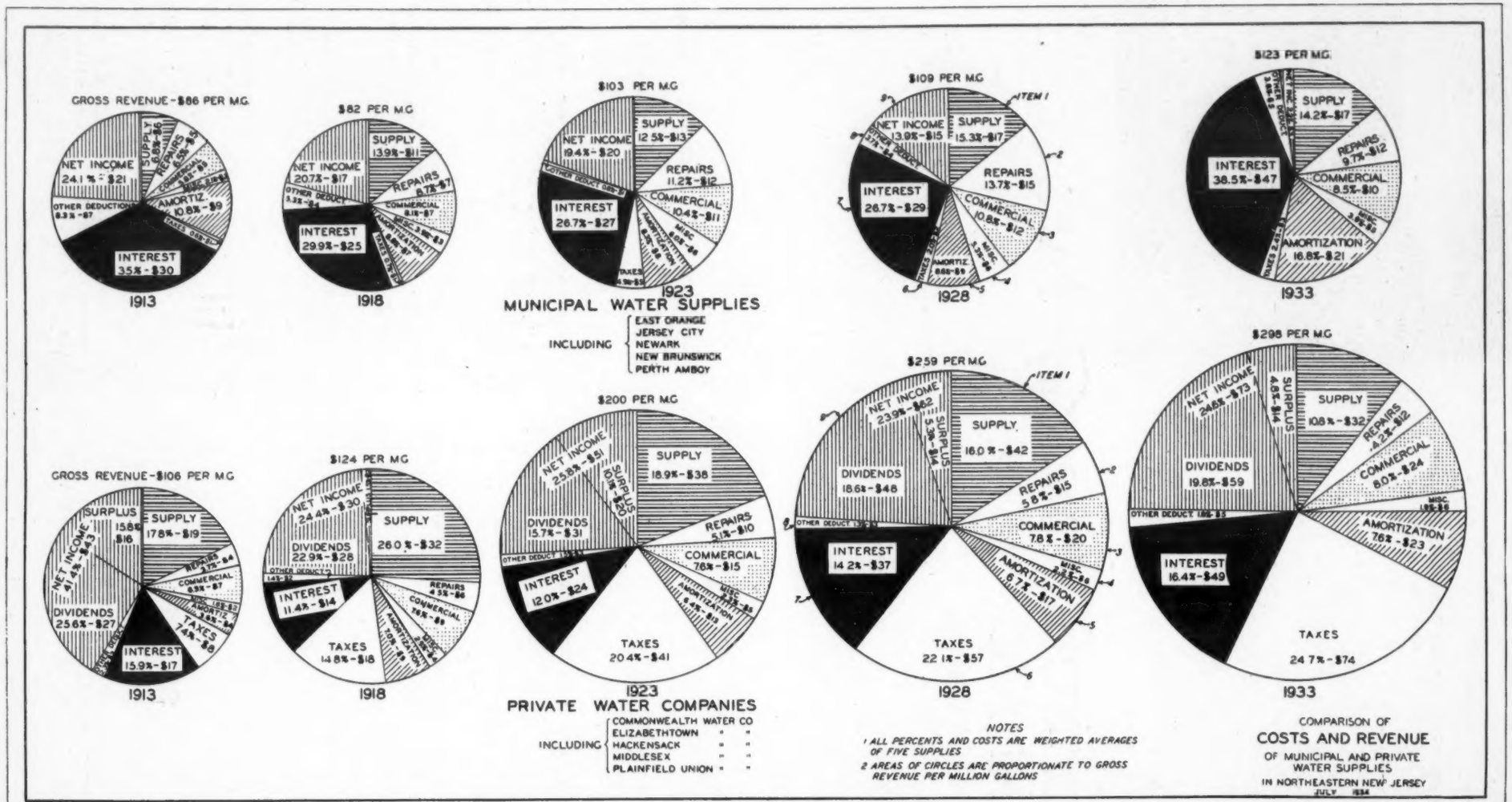
Trend of Ownership

In the early years of the development of water supplies in this country, the initiative was often taken by private enterprise. Later municipalities began building up their own water departments with the supplies owned entirely by the public. While there has seldom been any active competition between these two types, nevertheless a spirit of some rivalry has existed. Private companies at first were prone to render no more than a normal amount of service with the expectation of obtaining substantial profits therefor. In the last two or three decades, however, the regulatory work of fire underwriters, utility commissions and state health authorities, have tended to bring the two types of supplies to a more common level. Each of the two types has had and still has equally strong proponents and opponents.

Few states have experienced the conditions existing in the State of New Jersey, where private and municipal ownership have had interlocking systems, joint contracts and in some instances, actual competition. Furnishing water to entire communities started in New Jersey around the beginning of the nineteenth century, but it was not until 1850 that the real impetus took place that resulted in rapid expansion of water works facilities. With the flow of the largest river in the more populated area (the Passaic River) being controlled by private power development interests, it was only natural that private enterprise should utilize it as a major source of water supply. Thus in the latter part of the nineteenth century by far the largest part of the water delivered to consumers in the state was controlled by private interests. Arrangements were gradually made whereby some of these developments were taken over by the municipalities. It is too early to say just how far this movement will go, but it seems probable that there will be a continuing growth in municipal ownership. This latter condition seems to prevail throughout the country, although the situation in New Jersey is probably more conducive to the change than in most states.

Utility Commission Reports

In order to establish a foundation on which reasonable conclusions as to rates may be based, it is necessary to study the financial reports of the water supply systems. An excellent opportunity for doing this is afforded in New Jersey by reason of the fact that the Public Utility Commission, since 1912, has required all water utilities to file with it annual reports. This period of more than twenty years covers a wide variation in economic conditions. An analysis of these reports furnishes an admirable yardstick by which the costs may be measured. While the system of accounts used by municipal supplies is fairly well in accord with that used by private companies, there are certain individual differences. These may be neglected, however, in a general study such as is here reported, but it became immediately apparent that much could be learned by



Comparison of Financial Aspects of Municipal and Privately Owned Water Systems Charted to Scale

grouping the two classes of management and comparing them in that way rather than making individual comparisons of private vs. municipally operated systems.

Financial Comparison of Municipal and Private Systems

Loose statements have been made by various advocates for one side or the other in the controversy between municipal and private ownership. In order to truly evaluate the conditions as existing in northern New Jersey, data in regard to the five largest municipal and private supplies, that are owned outright or nearly so (in such a way as to permit comparison), have been gathered and reproduced in the form of the accompanying chart. The figures used have been taken from the annual reports submitted by these ten entities to the Public Utility Commission. All amounts shown on the chart were obtained by adding the figures reported by the five utilities comprising each group and expressing the total as a per cent of the total annual revenue of the group. Thus the percentages indicated on the chart are accurate within the limitations of the data in the Utility Commission reports. The actual dollars per million gallons figures are open to some slight variations in interpretation. For example, in the year 1928 the five private companies interchanged some water between themselves for which they charged and paid a wholesale rate. This interchange has been eliminated in the chart by simply dividing the total revenue of the five companies by the total volume of water produced at the original sources by these five companies. In order to make a true comparison, the same has been done with the municipal supplies, but it should be noted that the interchange in the case of municipal supplies is relatively small. The areas of the circles have been made proportional to the revenue per million gallons obtained by the above method.

While the figures presented cover five year intervals they must by no means be considered without reference to the intervening years, nevertheless this method does present the story in sufficiently complete form to permit drawing some rather definite conclusions. The writer has prepared partial data for all the intervening years and has found that the trend has been well typified by using the figures taken at five year intervals. Further information will be given later, however, to point out the effects of the depression.

In order to more fully comprehend the significance of the chart, an explanation of what each item includes and the reasons for the variations between the two types of supplies is shown in a key tabulation (see Table 1) together with the maximum and minimum percentages and dollars as taken from the chart. From this data, the reader may secure a fairly complete picture of the situation. One criticism that has been directed against the charted data concerns the lack of separation of collection and distribution of water. Unfortunately the system of accounting does not permit doing this completely and it was felt that it was better to combine the two under Supply, Item 1, than to give information that might be misleading.

The value of mass production in water supply, as elsewhere, was somewhat in evidence in this comparison. The five municipal supplies as a general average produced about twice as much water as the five water companies and sold it in a more condensed territory and at a generally lower elevation. This of course accounted, to a large extent, for the higher unit costs shown by the companies.

TABLE 1—COMPARISON BY ITEMS (See Chart)

Item	Expense Included Under This Item		Municipal	Private	Comments on Variation
1.	*Supply:* Impounding, pumping, purifying, transmitting, distributing	Min.	6.8%	10.8%	Private companies higher because of greater cost of purification, pumping to higher elevations and distribution over a wider and less thickly populated area.
		Max.	15.3%	26.0%	
	Per M. G.	Min.	$ 6.00	$19.00	
		Max.	17.00	42.00	
2.	*Repairs:* Repairs to all structures and equipment	Min.	6.5%	3.7%	Municipalities charge some items here that companies enter in capital account.
		Max.	13.7%	5.8%	
	Per M. G.	Min.	$ 5.00	$ 4.00	
		Max.	15.00	15.00	
3.	*Commercial:* Commercial, new business, administration and legal	Min.	5.8%	6.3%	Municipalities make a good showing here and apparently are not overloaded with political sinecures to the extent that might be expected. Usually they pay no office rent and have an advantage in this respect.
		Max.	10.8%	8.0%	
	Per M. G.	Min.	$ 5.00	$ 7.00	
		Max.	12.00	24.00	
4.	*Miscellaneous:* Insurance store and transportation and other general expense	Min.	2.1%	1.6%	The per cents do not agree closely, although the dollars do.
		Max.	6.0%	2.9%	
	Per M. G.	Min.	$ 2.00	$ 2.00	
		Max.	6.00	6.00	
5.	*Amortization:* All general amortization	Min.	8.3%	3.6%	Municipalities charge off more in per cent here than companies, as the latter prefer to maintain a high rate base. The dollars are usually in reverse order.
		Max.	16.8%	7.6%	
	Per M. G.	Min.	$ 7.00	$ 4.00	
		Max.	21.00	23.00	
6.	*Taxes:* Franchise, stock, real estate and other taxes	Min.	0.6%	7.4%	This item is one of the outstanding differences between the two types. Municipalities only pay on property outside of municipal limits, while companies pay on all property.
		Max.	4.9%	24.7%	
	Per M. G.	Min.	$ 1.00	$ 8.00	
		Max.	5.00	74.00	
7.	*Interest:* Interest on funded debt	Min.	26.7%	11.4%	Companies finance by both bonds and stock and hence are generally lower in this item while all of municipal debt interest is for bonds.
		Max.	38.5%	16.4%	
	Per M. G.	Min.	$25.00	$14.00	
		Max.	47.00	49.00	
8.	*Other Deductions:* Principally sinking fund payments	Min.	0.6%	1.3%	Companies generally are less because their bonds are less in proportion.
		Max.	8.3%	2.3%	
	Per M. G.	Min.	$ 1.00	$ 2.00	
		Max.	7.00	5.00	
9.	*Net Income:* Balance remaining from gross income after deducting all preceding items	Min.	2.2%	23.9%	Net income for companies may be roughly divided into dividends and surplus. If a proper proportion of dividends could be allocated to Item 7, both Items 7 and 9 would be in closer agreement than indicated here.
		Max.	24.1%	41.4%	
	Per M. G.	Min.	$ 3.00	$30.00	
		Max.	21.00	73.00	

TABLE 2—COMPARISON OF COSTS FOR 1932—1933 AND 1934
(Dollars per MG expressed in per cent of total cost)

		MUNICIPAL						PRIVATE COMPANIES					
		1932		1933		1934		1932		1933		1934	
Item	Designation	Pct.	Dollars	Pct.	Dollars	Pct.	Dollars	Pct.	Dollars	Pct.	Dollars	Pct.	Dollars
1.	Supply	19.0	23	14.2	17	14.3	17	11.4	34	10.8	32	11.1	33
2.	Repairs	12.2	14	9.7	12	9.9	12	4.0	12	4.2	12	4.5	13
3.	Commercial ..	11.4	13	8.5	10	7.5	9	7.4	22	8.0	24	7.2	21
4.	Miscellaneous..	4.7	5	3.9	5	3.7	4	2.0	6	1.9	6	2.3	7
5.	Amortization .	16.9	20	16.8	21	18.6	23	7.2	22	7.6	23	7.5	22
6.	Taxes	2.7	3	2.4	3	2.4	3	25.2	76	24.7	74	24.0	71
7.	Interest	39.9	47	38.5	47	35.5	43	12.5	37	16.4	49	16.2	48
8.	Other deductions ..	4.4	5	3.8	5	0.9	1	4.2	13	1.8	5	1.3	3
9.	Net income...	—11.2	—13	2.2	3	7.2	9	26.1	78	24.6	73	25.9	77
	TOTAL ...	100.0	117	100.0	123	100.0	121	100.0	300	100.0	298	100.0	295

Effects of Depression

Everyone familiar with utility construction and financing realizes that the limitation of any utility is fixed by the extent to which it can meet peak demands rather than average consumption requirements. Particularly careful planning for the future is required for water systems, if water is to be continuously furnished, unimpaired in quality and undiminished in quantity at a useful pressure.

The development of the large municipal supplies in New Jersey with ample reserve is an example of wise forethought. True, their development has caused a very heavy financial burden on water departments but these large supplies have been very essential during the dry years of 1930 to 1932 inclusive. A water shortage of no small proportion would have occurred during that period had advance planning been ignored. Since the water companies have to a much greater extent, followed a program of extension to satisfy immediate needs only, these have not had their net earnings so adversely affected during the depression.

During the pre-depression period one of the large municipalities had been expanding its supply system, the debt load for which was assumed during 1930. Combined with reduced revenue, the net effect has been the showing of an actual deficit in the averages struck for the municipal group during 1931 and 1932. Economies instituted during those years finally brought the municipal supplies to a point where the summation actually showed a profit for 1933 and 1934. To indicate what has been accomplished, Table 2 has been prepared showing the percentages and dollars for both municipal and private supplies for 1932, 1933, and 1934.

Retrenchment has not been confined to the municipalities but is also very much in evidence in the case of the companies. Items 1 to 4 inclusive might be termed operating expenses. In the case of the municipalities these totaled 45.1 per cent of total revenue in 1928, 47.3 per cent in 1932, 36.3 per cent in 1933, and 35.3 per cent in 1934. The corresponding figures for the companies were 31.8, 24.8, 24.9, and 24.6 per cent, respectively. This would indicate about a similar proportion of reduction in each case, although the companies instituted their economies in the early part of the depression while the municipalities delayed their principal curtailments until 1933.

Considering salaries, which have not been tabulated herein, it has been found that if a further reduction of ten per cent were made from the 1933 expenditure for actual wages, the net income would have been increased less than 3 per cent in the case of the municipalities and less than 2 per cent in the case of the companies. In other words, cutting salaries is not a lucrative field in which to reap large increases in net profits. One point of singular significance is that the companies have maintained their dividends at practically the same rate throughout the depression—a truly remarkable accomplishment.

As an indication of the extent to which these supplies have been affected, in so far as water consumption and revenue is concerned, it may be pointed out that for the municipalities, water consumption was 17 per cent less in 1933 than in 1929 and revenue decreased only 7 per cent. For the companies the loss in consumption was only 12 per cent whereas the loss in revenue was 10 per cent. No allowance has been made in these figures for the fact that the city of Elizabeth purchased its distribution system from the Elizabethtown Company in the interim and started purchasing some of its supply from Newark. If an adjustment were made for this, the loss for the municipalities would be greater while that for the companies would be less. The loss in both consumption and revenue has been principally in the industrial takings of water sold at the lowest rates. Naturally this has been reflected in a showing of greater revenue per million gallons during the depression.

Offhand one would be inclined to say that such losses are trivial compared with the average loss suffered by other industries throughout the country. It must be remembered, however, that in 1929 most water works had been expanded to take care of the same rate of increase as had been occurring during the 1925 to 1929 period and had the same rate continued, the demand for water would now be 15 per cent greater than in 1929 and the revenue at least 10 per cent greater. Thus, water utilities, in general, are probably on an average, operating on a gross income 20 per cent less than would normally be anticipated; and, at the same time, are carrying an overhead in plant investment (particularly insofar as the municipal supplies are concerned) nearly as great as if this additional amount were actually being earned. Until the slack has been taken up, there is no probability that the municipal systems will be capable of showing reasonable profits.

Future Policies

It is perfectly obvious that municipalities have been sailing too close to the rocky shore of deficits and in some cases have gone around—at least temporarily although their expansion program has been amply justified during recent droughts. The fault then lies not with the planning but with the rates charged for water by municipalities. The city of Newark, with its low rates, has found it necessary to add a surcharge of 15 per cent to its bills. This additional amount charged to the consumer is small compared to the reduction in wages of the Water Department employees and is distinctly stipulated as temporary whereas salary reductions may or may not be.

On the other hand private companies more than doubled their income per million gallons during the period of increase from 1913 to 1928, by taking advan-

tage of allowable applications to the Public Utility Commission for increases in rates whenever a desired increase in revenue seemed to be supportable. The city of Elizabeth, after taking over its distribution system from the Elizabethtown Water Company in July, 1931, using at first the same rates as those charged by the company, was enabled to reduce the rates about 20 per cent within 4 years. During the period of 1920 to 1930, the selected companies increased their rate base to correspond to prevailing prices. With a price index at present somewhat below that of the prosperous era, a reduction in the base and consequently in the rates, would seem to be equally justified. When it is noted that the five companies herein discussed showed an average common stock dividend of nearly 8 per cent during the worst depression year there can be little wonder that they have been a financial success in normal periods. Few other large businesses can show an equal consistent attainment.

Conversely, the municipalities (with rates usually too low) should raise rates to a point commensurate with the service rendered. Attempting to hold tax rates and water rates down by passing the burden along to be taken care of in the future, is rapidly losing favor. It is the duty then of municipalities owning water supplies to cast aside political expediency and follow the example of private companies in raising rates to a point insuring adequate return. As a business matter it is far better to be able to apply water department surpluses to reduce annual municipal budget requirements, than to dip into tax money to wipe out water department deficits.

The large sum paid out in the form of taxes by the companies is important but should not be overemphasized. It must be remembered that two-thirds of this tax money is returned to the companies in the form of fire protection revenue, a source of revenue which municipal water departments do not ordinary enjoy.

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Acknowledgment.—This article has been drawn from a paper read by the author before the New Jersey Water Works Association. However, additional information has been added and the subject matter amplified.—Editor.

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I. M. Glace Enters Consulting Field

An announcement has just been received from I. M. Glace to the effect that henceforth he will engage in practice as a Consulting Engineer. He will specialize in Water Supply, Sewerage and Sewage Treatment and Sanitary Control of Bathing Places.

Mr. Glace was formerly District Engineer of the Pennsylvania State Department of Health and is a registered professional engineer in Pennsylvania. He has long and efficiently served as Secretary of the Pennsylvania Water Operators Association, which he will continue to serve. He has established offices at 22 So. 22nd street, in Harrisburg, Pa.

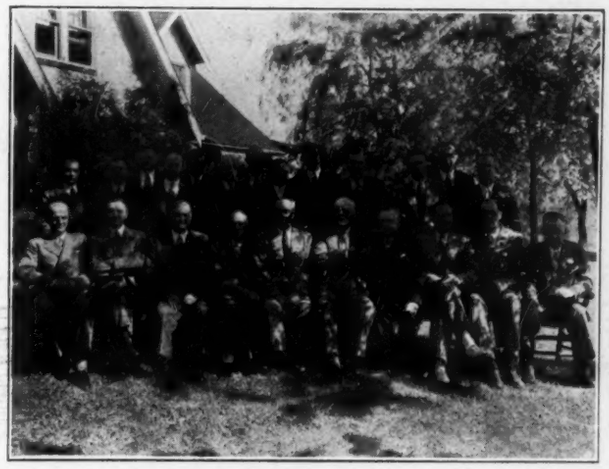
H. S. Morse Honored by Staff

H. S. Morse, Manager of the Indianapolis Water Company, was honor guest at a luncheon given him recently by 22 of his department managers and their principal assistants.

Harry E. Jordan, in speaking for the staff, said:

"I know of no other public water supply organization that compares with the Indianapolis Water Company in length of employment records among department managers and their principal assistants. This group of 22 men, for example, has a combined employment record of 541 years, an average of more than 23 years per man.

"Those of us gathered here today to pay our respects to Mr. Morse have seen splendid organizations wrecked



H. S. Morse and Executive Staff—Indianapolis Water Co.

Left to right (sitting): E. C. Schwier, F. C. Jordan,‡ C. W. Winkle,‡ E. C. Leible,‡ H. S. Morse, J. F. O'Donnell,‡ H. E. Jordan,† W. C. Mabee,† C. Blank,† T. C. M. Mauch.† (Standing): J. J. Daniels,* G. C. Staley,* Miller Hamilton, H. G. Coughlen, Jr., R. Swingley, Herbert Smith, E. G. McCreery,* Neil Kershaw, John Bruhn, G. W. Barker, H. W. Niemeyer, Homer Rupard, Alva Payne.**

**Length of service, 20 to 30 years.*
†*Length of service, 30 to 40 years.*
‡*Length of service, more than 40 years.*

and crippled by political influences and we can speak out boldly against this vicious practice."

Prior to his Indianapolis connection Mr. Morse served in municipal engineering and management projects in Louisville, Ky., Detroit, Mich., Cincinnati, Columbus, Cleveland and Akron, Ohio. He is a graduate of the Massachusetts Institute of Technology and is a national director of the American Water Works Association and the American Society of Civil Engineers. As a community leader, he is a member of several Indianapolis technical, business and civic clubs.

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Harry Jordan to Represent Water Supply Industry in U. S. Chamber of Commerce

Harry E. Jordan, of the Indianapolis Water Company, who is immediate past-president of the American Water Works Association, has accepted membership on the Natural Resources Department Committee of the U. S. Chamber of Commerce. He was selected to represent the country's public water supply industry.

An important consideration before this newly formed U. S. Chamber of Commerce committee is how best to develop and how to utilize to the greatest advantage the water resources of the nation.

Pacific Northwest Sewage Works Association Holds First Conference At Lewiston, Idaho

The Pacific Northwest Sewage Works Association started in Eugene, Ore., in 1934, held its first Annual Conference recently in Lewiston, Idaho.

The new association, which is the latest addition to the Federation of Sewage Works Associations, is composed of members from the States of Oregon, Washington, Idaho and the adjoining Canadian Province—British Columbia.

Officers elected for the ensuing year were:

Chairman—Carl Green, State San. Engr., Portland, Oregon.

Vice Chairman—W. V. Leonard, State San. Engr., Boise, Idaho.

Vice Chairman—M. K. Snyder, Washington State College, Pullman, Wash.

Secretary-Treasurer—Fred. Merryfield, Oregon State College, Corvallis, Oregon.

The Program

The following papers were presented:

"Sulphite Waste Disposal"—Fred. Merryfield, Professor of C. E., Oregon State College, Corvallis, Ore., constituted a review of the present status and practicability of the known methods of disposing of digester liquor from the sulphite process of pulp manufacture—a timely and valuable paper.

"Baker's Sewage Treatment Plant"—By L. R. Stockman, Cons. Engr., Baker, Ore., incorporated a description of the recently built Baker, Ore., 1.2 M.G.D. plant, involving circular (revolving distributor) filters and mechanical sedimentation and separation digestion tanks. Operation results were reviewed. The plant cost $98,000; was constructed as a P.W.A. project.

"California Sewage Treatment"—By R. E. Koon, Cons. Engr., of Portland, Ore., constituted a digest of his observations and impressions gained during a trip of inspection to important sewage treatment works in California and Arizona.

"The Action of Chlorine Compounds in Killing Microscopic Organisms" was the title of a film shown and explained by George W. Mitchell, Wallace and Tiernan Co., Seattle, Wash. In this film the rates of kill and effectiveness of chlorine vs. chloramines were clearly and effectively illustrated.

The following men registered for the First Conference of the Pacific Northwest Sewage Works Association:

T. B. Jackson, president and general manager, Boise Water Corp., Boise, Idaho.
J. M. Welsh, sanitation inspector, Boise, Idaho.
F. H. McConnell, city engineer, Caldwell, Idaho.
W. V. Leonard, state chemist and state sanitation engineer, Boise, Idaho.
W. P. Hughes, city engineer, Lewiston, Idaho.
Carl Aldrich, sanitation engineer, Lewiston, Idaho.
A. G. Darwin, editor, Lewiston, Idaho.
J. H. Griffiths, I. E. R. A. engineer, Boise, Idaho.
P. N. Beatty, superintendent water works, Caldwell, Idaho.
L. R. Stockman, consulting engineer, Baker, Ore.
R. E. Koon, consulting engineer, Spalding Bldg., Portland, Ore.
J. W. Cunningham, consulting engineer, Spalding Bldg., Portland, Ore.
Carl Green, state sanitary engineer, Portland, Ore.
G. E. Bjork, Western Cons. News, Portland, Ore.
Fred Merryfield, assistant professor, Oregon State College, Corvallis, Ore.
M. R. Hamilton, superintendent water department, Centralia, Wash.
Hiram C. Green, commissioner public works, Centralia, Wash.
M. K. Snyder, professor sanitary engineering, Washington State College, Pullman, Wash.
E. Knittel, water superintendent, Lynden, Wash.
A. D. Butler, city engineer, Spokane, Wash.
A. S. Buchicker, sewer engineer, Spokane, Wash.
G. W. Mitchell, district manager, Wallace & Tiernan Sales, Seattle, Wash.
E. French Chase, city sanitary engineer, Seattle, Wash.
R. M. Harris, public health engineer, city engineer, Seattle, Wash.
R. F. McLean, superintendent water and sewer departments, Walla Walla, Wash.
H. S. Griggs, Jr., Hooker Electro-Chemical Co., Tacoma, Wash.
C. J. Phillips, city engineer, Puyallup, Wash.
Brian Shera, sales engineer, Pennsylvania Salt Mfg. Co., Tacoma, Wash.
G. M. Irwin, city engineer, Victoria, B. C.

Roger Esty Choice for Presidency Of N. E. W. W. A.

Roger W. Esty

The Nominating Committee of the New England Water Works Association has reported out the name of Roger W. Esty, Superintendent of Water Works, Danvers, Mass., as its unanimous choice in the selection of a nominee for the presidency in 1935-36.

Warren J. Scott, Director of Sanitary Engineering, County Department of Health, Hartford, Conn., is the choice as vice-president. H. K. Barrows, Massachusetts Institute Technology, Cambridge, Mass., was named Director, and Leland G. Carlton of Springfield, Mass., has been nominated as Treasurer, to continue in that position.

Water Works and Sewerage wishes to compliment Mr. Kingsbury and his committee (Heffernan, Calderwood, Parker and Halpin) on their slate. .....

Organization of Construction Equipment Association

As this issue of Water Works goes to press a new association of construction equipment manufacturers is being formed for the purpose of maintaining the great equipment industry on a firm and proper footing in all respects, and especially to prevent a return to objectionable conditions which existed in the industry during the years immediately preceding 1934.

This development is the outgrowth of a meeting of a large group of manufacturers held in Chicago on July 18. At that meeting, the following organizing committee was appointed:

Chairman, S. F. Beatty, Austin-Western Road Machinery Co.; Morgan Butler, Butler Bin Co.; C. L. Dunham, Sullivan Machinery Co.; George M. Etnyre, E. D. Etnyre Co.; W. B. Greene, Barber-Greene Co.; O. G. Mandt, Jaeger Machine Co.; J. R. McGiffert, Clyde Iron Works; Wm. Parrish, International Harvester Co.; L. W. Yerk, Pioneer Gravel Equipment Manufacturing Co.

The committee has established headquarters at 410

(*Continued on page 293*)

Pennsylvania State College's Administration Building (Headquarters)

MEETINGS OF THE PENNSYLVANIA WATER WORKS OPERATORS AND SEWAGE WORKS ASSOCIATIONS*

THE Ninth Annual Conference of the Pennsylvania Sewage Works Association and the Eighth Annual Conference of the Pennsylvania Water Works Operators Association were held at State College, Pa., June 24th-28th.

The attendance of 275 or more at the Water Works Operators Association Conference established a new record (265 registered) for this association. The Sewage Works Association Conference, at which 125 registered, was held the first two days. Many remained to participate in the annual golf tournament held on the State College links between the two associations and to attend the Water Operators Conference held the following two days.

Awards

A high-light of the Water Operators Conference was the presence of Pennsylvania's recently appointed Madam Secretary of Health — Dr. Edith MacBride-Dexter. She addressed the association briefly and thereafter presented the awards to the member-authors of the two prize-winning papers presented.

To Richard D. Hoak, of Lancaster, Pa., went the President's Cup, donated to the association by Harry M. Freeburn, as its retiring president. The new cup is to be presented to that member presenting the most meritorious paper each year. Mr. Hoak's paper dealt with "The Correlation of Laboratory Media and Methods of b. Coli—b. Aerogenes Differentiations."

Harry M. Freeburn, Retiring President (Donated a cup)

Chas. L. Fox, President-Elect (Camera shy but gave in)

A paper on "Public Relations" by W. L. Eisert, Chief Engr., Northeast Water and Electric Corporation, Lemoyne, Pa., was selected by the Awards Committee as a close second. To Mr. Eisert was presented a Scroll of Honorable Mention.

In the "Gadget Contest" the first prize was voted Harry Krumm of Allentown, Pa., for his ingenious "Automatic Electro-Magnetic Hypochlorite Solution Feeder." Second prize went to R. W. Woodring of Bethlehem, Pa., for his "Sand Expansion Indicator" for use in determining effective sand bed expansion during the washing of filters.

In the golf tournament the prize for low gross (78) was won by R. L. Tyler (Scottdale), and the second low gross score (84) was turned in by E. C. Trax (McKeesport). H. W. Scholey (Millville, N. J.) and W. H. Eastburn (Philadelphia) were winners in the Kicker's Handicap.

Both Associations Take Stand in Recent Dismissals of State Engineers

Both of the associations went on record as opposing the recent action of Governor Earle of Pennsylvania in dismissing employees of the Engineering Division of the State Department of Health. Amongst these were I. M. Glace, capable and popular District Engineer, who had served the Department for 28 years. "Mike" Glace, who has so well served the Water Operators Association as its Secretary, received the unanimous vote of the association in his re-election and a vote of confidence and appreciation. [Elsewhere in this issue appears an announcement that Mr. Glace is entering the field of consulting engineering—Ed..]

From both associations went letters to Governor Earle directing attention to the high regard of Pennsylvania's water-works and sewerage operators for the capabilities of field personnel of the Engineering Division of the Department. That, any replacement of such men, possessed of experience and training of several years (with new men), was at once not only a questionable procedure economically but also constituted a hazard to the general Public Health situation in the State. That,

*This report of these two meetings was prepared for our July issue. We regret, however, that it had to be held over for the August issue, because of lack of space in the earlier issue.—Editor.

Madam Sec. of Health Dr. Edith MacBride-Dexter (As charming as she looks)

W. L. Stevenson, Chief Engr., State Dept. of Health (Likes his new boss)

"the existing personnel, of long experience, has become an asset not alone to the Commonwealth, but to municipalities and water companies in connection with their respective problems"—was stated in the letter unanimously approved by the membership of the Water Operators Association. A very similar letter was drafted and sent by the Sewage Works Assn. To Madame Secretary of Health, Dr. Edith MacBride-Dexter, went copies in support of opinions expressed to her during the meeting by a joint committee named for that purpose, and also the drafting of the letters.

Operator Licensing and Short Course

The Sewage Works Association having voted favorably in 1934 on the desirability of having established an Operator Licensing Act for Pennsylvania, the Water Operators' Association taking a vote on its Licensing Committee's proposals before the conference in 1934, Professor E. D. Walker, as Chairman of the Committee on Licensing in both associations, reported that by votes cast in a letter ballot during the year, the proposal to have the Water Operators' Association draft a Licensing Act for presentation to the State Legislature suffered defeat. Such was unfortunate and was believed to be due to unfounded opinion that a Licensing Act would place hardships on employees of private water companies and their employers. He pointed out the existing lack of power by the health authorities of Pennslyvania, or any other regulatory body, to prevent political appointments of unskilled operators to replace experienced and qualified men of long service and dependability. The committee wished again to stress the advantages of a Licensing Act which would sooner or later become an actuality. Such an Act might far better be an instrument prepared by water works operators and executives represented in the association and, thereby, patterned to their best interests rather than have the inevitable happen—an act prepared outside. The committee urged the drafting of a revised bill for circulation during the year preparatory to taking a vote at the 1936 meeting. The association voted favorably on such recommendations and the enlargement of its Licensing Committee.

Concerning the first year's Short School for Operators held at State College, the members voted unanimously to request the college authorities to continue to hold the valuable Short Course annually. The same action was taken by the Sewage Works Association.

Officers Named

The following officers were named for the year 1935-36:

Water Operators' Association

President—Chas. L. Fox, Penna. Water Company, Wilkinsburg, Pa.

1st Vice-Pres.—Chas. W. Kunkel, Johnstown Water Company, Johnstown, Pa.

2nd Vice-Pres.—Wm. C. Emigh, City Engineer, Coatesville, Pa.

Sec'y-Treas.—I. M. Glace, 22 So. 22nd street, Harrisburg, Pa.

Sewage Works Association

President—E. B. Wagner, Supt. Water and Sewage, Dowingtown, Pa.

1st Vice-Pres.—R. R. Cleland, Penna. State College, State College, Pa.

2nd Vice-Pres.—F. S. Friel, Cons. Engr., Philadelphia, Pa.

Sec'y-Treas.—L. D. Matter, State Department of Health, Wilkes-Barre, Pa.

Papers Before the Water Operators' Association

The evening before the official opening of the conference, Harry J. Krumm of Allentown, Pa., lectured to a sweltering but packed meeting on "Bacteriological Analysis and its Application to Water Works Practice." Thereafter he showed that remarkable film of water-life prepared as the result of several years of observation and study of fresh water biology by Major John B. Hawley, Civil Engineer of Fort Worth, Texas, who in recent years has pursued this type of work largely as a hobby. The Hawley film is probably the finest of its kind in existence and Mr. Krumm has been fortunate in procuring a copy through Major Hawley after having seen the film exhibited at the Cincinnati Convention of the A. W. W. A.

The opening paper on the program of the following day was:

"Fire Protection"—by *W. C. Hawley,* Supt. and Chief Engr., Penna. Water Service Co., Wilkinsburg, Pa.

Mr. Hawley said that the underlying facts and basic elements of his subject had been made available in a paper by Metcalf, Kuichling and Hawley (himself), which was presented before the American Water Works Association in 1911, and could be found in the Journal of the Association. He said the published paper rather

Here and There on the Campus

1 2 3 4 5

1—*Lloyd Hess and Martin Flentje;* 2—*"Prof." Carpenter and Harry Beckwith;* 3—*Eisert and His Gang of Northeasters;* 4—*Chester Drake and Seth Van Loan;* 5—*P. H. Dixon, Flentje, H. G. Tompkins*

thoroughly covered the topic and in fact little that was basically new had developed since to justify revisions or additions. Amongst the important facts therein developed were that in the smaller communities at least 75 per cent of the cost of the water works system was chargeable to fire protection requisites. In municipalities of approximately 50,000 population that figure became 30 to 35 per cent and dropped to 15 per cent in the largest cities. The average per capita annual cost for fire protection features of the water works system was then (1911) about $1.00 (from $1.50 in small to 60 cents in large cities), and was now probably from 25 to 50 per cent higher. It was apparent that the payment from the general property tax to municipal or private water works did not come up to the actual cost of providing the protection when considering the material increased cost of the system over and above that necessary for providing domestic or industry supply requirements alone.

In Wisconsin the Public Service Commission (or its equivalent) for a few years at least, had made calculations of the true cost of providing fire protection and had fixed rates for such accordingly. In Pennsylvania the Commission had, to his knowledge, never undertaken to properly evaluate fire protection service nor to set rates to adequately cover the actual cost—to say nothing of a reasonable return of profit. His company had not had the courage to ask for rates requisite to cover even the actual cost. The inference was that the water consumer had to bear the cost, included in the charge for the commodity, rather than following the more truly equitable method of collecting from the real beneficiary—the owner of the property protected.

As to computing the cost of the fire protection elements in a system, Mr. Hawley felt that the most logical method was the "proportional method." This involved estimates of cost of two systems serving the same territory—one for fire protection alone and the other only sufficient to serve the normal requirements of domestic and industrial service—i.e., water consumed. By dividing the cost of the first by the sum of the first and second the resulting figure was the proper factor (per cent) to apply to the actual cost of existing plants to arrive at the added investment required for providing fire protection features. The net cost would be the sum of interest, maintenance, depreciation and taxes on the extra value of the system, plus the pro rated cost of superintendence and other operating expenses. While not exact, the result had been found sufficient for all practical purposes.

The method of deriving fire protection expense solely from rentals on hydrants had not been satisfactory. In many cases the municipality had reduced the number of hydrants to a point where deficient protection was the result and also a return far below that adequate or fair to the water utility was the consequence. Mr. Hawley said that he believed that the Penna. Water Company was the first to take the initiative in charging the city on a per mile base rate annual charge on the larger mains required. To this was added a nominal rental for hydrants, which would merely pay carrying charges on the hydrant investment and maintenance. This combination charge had since found considerable favor elsewhere. A scheme, advocated by some and known as the "inch-mile method," which took into account the pipe diameters and miles of each, seemed needlessly refined to him.

In discussing sizes of mains, Mr. Hawley said, that if pipes were purchased on the basis of capacity 30 years hence, instead of per ton of cast-iron, the diameters would be greater in the majority of instances. In this direction—(expectancy of capacity after a given period of service)—Mr. Hawley stressed the increasing evidence of the value and economy of using only pipe with protective linings, rather than gamble on what the future will show in the rate of tuberculation and progressive costly friction increases. It was also becoming apparent that net economy without loss of system efficiencies could be had by using sharper bends and shorter fittings of lighter weight. These had previously been questioned because of expected greater friction, but actual test had proved such assumptions unfounded.

As to gate valves on the system, it should not be necessary to close more than four (at most six) valves to cut out any section of distribution system desired. At least an opening and closing test of all gate valves should be given annually. As to fire-hydrants, it was hardly necessary to say that every hydrant should be preceded by a shut-off valve on the branch to it from the main. And, as to spacing of hydrants, the number per mile of pipe should be not less than ten, but too predominantly the spacing was greater. In built up high value districts 200 to 250 ft. spacing was proper. In districts where the pressure at the hydrant was 40 to 50 pounds it would be impossible at the end of 300 to 400 feet of fire hose to use the 1¼ inch nozzle effectively. However, if the 1 inch or ¾ inch nozzle was substituted an effective stream, sufficient for small buildings, would result.

R. F. Goodhue, Middle Department Rating Association, Philadelphia, Penna., in discussing the paper, was highly complimentary of Mr. Hawley's work and the methods proposed by him. He said that a common fault of water supply systems was that the high investment in other features to provide adequacy of fire protection was too frequently negatived by a deficiency in main capacities. Engineers had been fallaciously assuming capacity coefficients after a given period of pipe service which had not been realized. Without proper protective linings, the old assumption that the coefficient "C" in pipe capacity prediction would be 100, at a point one-half way to its full life expectancy, had been actually more nearly 60 than 100. He considered it time to increase the factor of safety in laying mains, and that meant the need of generally larger pipes or the insistence on protective linings of a durable nature. With

Here and There on the Campus

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1—*Scholey, O'Donnell, Sigworth;* 2—*Wirtz, Schnabel, Foote;* 3—*Headquarters;* 4—*Goehring, Fox, Trax;* 5—*Fergus, Kinsel, Taggart, Eastburn, Johnson*

Joseph A. Beck, Atty., Pittsburgh

Earl Devendorf, N. Y. State Dept. of Health

mains of ample size, costly high pressures maintained on the system were not necessary nor justified. Efficiency of modern fire pumpers had rendered it possible to carry 38 pounds normal pressure on mains supplying a pumper delivering 2,500 g.p.m. and still left a residual main pressure of 10 pounds. The pipe size, however, must be sufficient to supply the pumper with some positive head on the suction line at all times.

Main breaks had been traced principally to the sidewise vibrations caused by the heavy trucks of modern traffic. Deeper cover was the only reliable preventative of such breakage. Another common weakness had been the lack of efficient valve maintenance. To keep valve stem, stuffing box, etc., in positive working condition old oil from automobile crank-cases had been effectively used for filling valve boxes. As to hydrant spacing, inadequate numbers of fire hydrants and faulty locations had too often nullified major investments. Requirement of 600 ft. maximum run between hydrants had been shown reasonable because through 600 ft. of hose a hydrant pressure of 250 lbs. would be required to produce a 250 g.p.m. fire stream from the nozzle. The average spacing of fire hydrants in Pennsylvania (municipally owned systems) was roughly one hydrant to serve every 218,000 sq. ft. On water company's systems the firgure was much higher and the hydrant rental charged ($35 or more per hydrant per year) was responsible generally for the resistance to increasing the demand for more ample protection. With Mr. Hawley, he agreed that the flat rental per hydrant was an inequitable and a faulty method in that it served as an obstacle to good hydrant protection. Instead, a graduated charge based on the mile-inch main factor or similar procedure was the more scientific and justifiable scheme by far—and one which municipal officials could not alter at will by limiting the number of hydrants.

"Legal Responsibilities of Water Works Officials for Typhoid Fever"—by *Joseph A. Beck,* Esq., Attorney at Law, Pittsburgh, Penna.

Mr. Beck, at the outset, stressed the fact that because of the corporate functions of municipally operated water systems, cities, just as much as privately owned corporations, were legally responsible for injury to body or health which could be shown to be a result of proven negligence in their functions of supplying the consumer with a product non-deleterious to health. In exercise of governmental functions and duties, municipalities had been held exempt from liability, but not so when utility functions had been involved. The status and rights of municipalities in respect to water supply had been repeatedly held by courts to be substantially similar to that of private water companies. In his comprehensive paper, Mr. Beck cited and referred to practically every important court decision. He quoted paragraphs from a number of these, including those wherein municipalities had also been held to be liable for damages from broken mains just as a private corporation would have been. Nevertheless, there remained to his mind "at least a delicate distinction" between municipal and private enterprise which was not to be overlooked in assuming liability.

Mr. Beck discussed certain outstanding court cases, with the object of showing that it was always necessary in damage suits for the plaintiff to establish proof of—(a) negligence, (b) that the illness was caused by the water (a difficult matter), (c) that the plaintiff was in no manner contributary to the damage or illness by his own negligence. He stated that in all but two states (Ohio and Texas) damage from water borne diseases contracted from a supply served by industrial plants, was held to come under the Workmen's Compensation Act. In Pennsylvania such claims had not yet been put to any decisive test.

As to personal liability of water works operators, Mr. Beck said that the employee of a water company or city could (in fact) be sued jointly with the employer for negligence to which such employee had been contributory. It had been usual that the employer had stood the damages alone, but that with changing conditions employee responsibility to a greater degree could be anticipated and in every case he already had a social responsibility of insuring the safety of water supply which came ahead of material responsibility.

[As a reference work on the subject covered, Mr. Beck's paper is the most valuable contribution of its kind that has come to our attention—Ed.]

Earl Devendorf, Asso. Director of Sanitation, New York State Department of Health, complimented the author and cited cases wherein New York municipalities and officials thereof had been held responsible and liable for water borne diseases. In the famouse Olean (N. Y.), case in which 5,000 cases of intestinal disturbances had preceded the costly typhoid outbreak, traced to a leaking suction line crossing a polluted stream and a cracked well casing, the courts had held the Water Commissioners and Superintendent responsible individually. The city of Olean had to issue bonds to the amount of $450,000 to pay damage claims and the court had allowed the plaintiffs claims for all costs.

Another instance was that at Schenectady which had been far less serious, but again the city had paid out $90,000 on damage claims resulting from a water borne epidemic, held to be caused by negligence on the part of city water works employees.

"Typhoid Fever"—by *C. F. Drake,* Supt. of Filtration, Pittsburgh, Pa.

Mr. Drake, who has for many years pursued a study

Norman J. Howard (Comes down from Toronto)

Robert Spurr Weston, Boston, Mass. (Pioneer of Water Purification in America)

M. M. Gibbons, Rahway, N. J. (Has more than his share of taste troubles)

Chester Drake, Pittsburgh (Knows his typhoid statistics)

of typhoid fever and its occurrence, distribution and trends in various parts of the world, illustrated by slides the "past, present and probable future" in respect to typhoid and the influence of purer water supplies and general sanitation thereon. Being largely statistical it is difficult to report Mr. Drake's paper adequately, but the fact that during the last 14 years America had shown a 50 per cent reduction in number of typhoid cases, and even so there had been reported 27,000 cases in the U. S. A. during the first 5 months of 1935, was impressive. Large cities showed the best typhoid records but taking the state record for Pennsylvania, including all rural areas, the recent record compared favorably with the leading cities and 35 or the 54 larger cities of the state had had a typhoid death rate of zero for the year.

Seth M. Van Loan, Deputy Chief, Department of Water Supply, Philadelphia, pointed out by graphical presentation, the effectiveness of typhoid reduction in Philadelphia when water filtration was established there. Again in 1913 a vigorous campaign to eliminate dangerous cross connection between private (industrial) and public supply had brought about another reduction. He said that possible pollution from cross connections was being watched for by routine sampling from the distribution system at 29 stations—each being covered at least 2 to 3 times every week. Mr. Van Loan cited the marked drop in Toronto's typhoid with the advent of controlled chlorination in 1910. A list of cities, in which suits had been won by plaintiffs claiming damages resulting from water borne disease, was appended to the discussion.

"The Causes of Tastes and Odors and Methods of Correction" — by *Norman J. Howard,* Director of Laboratories, Department of Water Supply, Toronto, Ont.

Among the outstanding papers was that presented by Mr. Howard. Naming the many sources of tastes and odors in water he placed emphasis on the end products of sewage degradation in water courses and the putrefaction of sludge deposited in streams, or in coagulation basins or the filters themselves. Then, too, the secondary summer tastes developing in dead ends of mains was another source of embarrassment to operators who had produced a satisfactory water leaving the plant.

Treatment for correction of tastes would be found to differ as the conditions differed. Better coagulation was always helpful. At Toronto super-chlorination followed by two hours' contact and thereafter dechlorination with sulphur-dioxide continued in use. It had one disadvantage—that of requiring close control in the dechlorinating operation. If residual chlorine was carried into the mains, after-tastes out in the far reaches of the system were created. To cope with odor or tastes created by decomposing organic matter the most successful treatment appeared to be aeration, followed by *heavy* chlorination of the raw water and powdered carbon applied near the filters and possibly some also in the raw water. For preventing tastes produced in prechlorination practice the application of ammonia *first* had been effective. Ammoniation as a taste preventer in filtered water had also been proven, but it was always advisable to proceed cautiously in testing the ammonia-chlorine treatment as it had been known to increase taste complaints in some cases. (Mr. Howard possibly had in mind the unloading of dirty filters when applying ammonia-chlorine per-treatment and the loosening of deposited slimes on main walls in the distribution system. Also the possibility of residual chlorine combining with products of summer putrefaction out in dead ends. —Ed.) On the whole, for filtered supplies, the use of powdered carbon had been the most universally successful remedy, and its use required no careful control. With prechlorination its use was even more efficacious and carbon and prechlorination went hand in hand whereas prechlorination without carbon was a hazardous practice if tastes were to be avoided. In specific instances, notably in organic industrial pollution cases, the use of permanganate to the raw water in combination with chlorination had proved to be an effective remedy. For unfiltered waters, and for the purpose of preventing taste production in the pipe system, the ammonia-chlorine treatment had been most effective.

M. M. Gibbons, Supt. of Filtration, Rahway, New Jersey, who had been faced with a serious industrial pollution and tastes highly resistent to treatment, had found nothing short of super-prechlorination and carbon, with permanganate used in addition for the most resistent conditions, as a satisfactory remedy. Superchlorination and dechlorination failed to meet the needs. Without permanganate 2.5 to 6 p.p.m. pre-chlorine dosage, 5 hrs. contact (residual Cl of 1 to 2 p.p.m.), then 10 to 20 p.p.m. powdered carbon to the filters was not always successful in plant practice. The routine adopted consists of carbon applied between the primary and secondary coagulation basins and ammonia-chlorine beyond the filters. Permanganate is used at intervals when needed. For algae tastes prechlorination and carbon had been the most successful and Mr. Gibbons stressed the value of rapid thorough mixing when adding the carbon. A comparison of its application to the raw water vs. the applied, had shown no material difference in effectiveness or economy at Rahway.

Prize Papers

After presenting the awards to Messrs. Hoak and Eisert as authors of the prize winning papers, Dr. Edith MacBride Dexter, Secretary of Health, in a brief address, stressed her interest in the work of the associa-

Richard D. Hoak, Lancaster (Won the president's cup)

Jas. J. Malone, Supt. Water Works, Lancaster, Pa.

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1—John Keunen (Pittsburgh); 2—Ike Walker (Philadelphia); 3—G. F. Linn (Pittsburgh); 4—Ed. Trax (McKeesport); 5—Fred Stuart (New York); 6—Charles Bruce (Cumberland, Md.); 7—W. A. Baumgartner (Newark, N. J.)

tion by stating that she had been closely identified with two important water borne typhoid outbreaks—one in Erie and the other in Grove City, Pa. Even in the face of the material reduction of the typhoid death rate in the state, Pennsylvania could further improve its standing as the 16th from the top of the list of states. She pointed out the hazard of "resting on the oars," letting down in vigilance or assuming water borne typhoid to be under complete control. That breakdowns in water purification processes had been responsible for outbreaks of importance in recent years, was ample proof that constant and continuous care was essential in water purification practices.

"Correlation of Culture Media for Coli Aerogenes Differentiation" was the title of the first prize paper presented by Richard D. Hoak, Chemist, Water Department, Lancaster, Penna. His paper was a compendium on the many proposed and the favored confirmatory laboratory methods for differentiation of intestinal and soil organisms, with a brief discussion and comments on each. He then reported on a series of studies at the Lancaster Filter Plant looking to the evaluation of the several proposed methods and existing Standard Methods of the A. P. H. A. and A. W. W. A. The conclusions drawn were that none of the tests when taken alone could be considered completely satisfactory. He thought that the use of media for direct plating out of samples on solid media, and taking count of the typical colonies on such selective media, held the greatest promise based on practical aspects. Brilliant Green Agar was one which would allow the count to be made after 18 hours of incubation. For confirmatory test he had found citrate-broth both simple and dependable in differentiation between b. Coli and the cloud producing b. Aerogenes.

"Public Relations"—the paper voted second place by the committee—was presented by W. L. Eisert, Chief Engr., Northeastern Water and Electric Co., Lemoyne, Pa. In his excellent discussion of Public Relations—the element given highest consideration by progressive water works executives in modern management—Mr. Eisert listed the many little things which in composite went to make good-will (or bad) and thereby the nature of relationship between the public and the utility. Good housekeeping and efficient maintenance of equipment had come to be considered one of the most important factors in creating good-will. Good housekeeping, moreover, applied to the state of mind of employees of the water-works as much as to the appearance of its personnel and physical properties. That meant politeness, courtesy, tolerance, in addition to the eye appeal. The standing of executives and employees in the community and their show of public spiritedness were as important as the proper maintenance and painting of fire-hydrants and mobile equipment of the utility. It had been learned that much was to be gained by carefully listening to expected criticism from consumers and thereafter turning the tide by taking them into the confidence of the employee. Selling the public on what's actually behind the water, including the hidden values of fire protection, was a matter of the highest importance. So much depended upon the friendship and regard of the public in present day utility operation that this matter of public relations should stand uppermost in the thoughts of every water-works employee. If so, the end sought would be attained.

Papers presented, which can not be adequately abstracted in the available space and therefore are reported by title only, were:

"Water Works Operating Experiences," presented by Robert Spurr Weston, Consulting Engineer of Boston, Mass., and a pioneer in the development of water treatment in America. Discussion was contributed by M. E. Flentje.

"Recent Progress in the Art of Water Supply," which was covered in a paper by Thomas H. Wiggin, Consulting Engineer, of New York, and discussed by F. C. Foote, Consulting Engineer of Pittsburgh, Penna.

(Being primarily an association for operators, it is regretted that the customary symposium of short papers presented by a group of operators, in what was known as "The Trouble Hour," was missing from this year's program. Such papers which set forth plant problems (troubles) of the operators and, more important, methods by which these were overcome or corrected, have always proved to be a highly interesting and helpful feature of previous meetings.—Editor.)

PAPERS BEFORE THE SEWAGE WORKS ASSN.

(President R. L. Phillips—presiding)

The customary lecture on the evening preceding the official opening of the conference was given this year by Dr. J. A. Sperry, of the State College faculty, whose subject was "Types of Bacteria Affecting Sewage Purification."

During the ensuing discussion, Dr. Sperry stated that there was little reason to believe that streptococci infection of sewage workers was likely to become a serious matter. This, because sewage streptococci were of the non-hemolitic type. Entry of bacteria into the blood stream might in itself become serious, however, and the resistence of the individual would be the chief factor in his safety when exposed to possible general infections from sewage handling.

Dr. Rudolfs pointed out the relative lack of danger from digested sewage solids by stating that pathogenic

R. L. Phillips, Meadville, Pa., Retiring President

E. B. Wagner, Downingtown, Pa., President-Elect

organisms died off in digestion tanks rather rapidly—99 per cent disappearing within the first 48 hours at temperatures in which digestion proceeded normally. Someone called attention to the resistence of the tuberculosis organism to sewage treatment processes. Even in the effluent of slow sand filters had these resistent organisms been found. Chlorination had been found effective on b. tuberculosis if the chlorine be applied in its acidic form (chlorine gas or chlorine water), whereas, in an alkaline condition (hypochlorite) the chlorine could not be considered as effective. Pathogenic organisms in general were more susceptible to destruction in an acid than in an alkaline medium. It was also pointed out that an outbreak of Jaundice had been traced to water polluted by sewage containing the Jaundice organism.

To those interested in sewage biology, Dr. Sperry recommended two books which he considered the best available:

(a) "Index to the Chemical Action of Micro-organisms on Non-nitrogenous Matter"—Waxman. (Publisher—Chas. Thomas, Springfield, Ill.)

(b) "The Chemical Activities of Micro-organisms"—Kluyber. (Publisher—Univ. of London Press.)

The conference was officially opened the following morning with a few remarks of welcome by Dean R. L. Sackett of the School of Engineering. Then followed an outstanding operating paper by Mr. Altemus.

"Operation of the Norristown, Pa., Sewage Treatment Works"—by *Frank Altemus,* Supt. of Treatment Works, Norristown, Pa.

Mr. Altemus described briefly the Norristown plant, serving a population of 36,000 built for $350,000 and placed in operation in 1932, which provides screening, sedimentation, chlorination and separate sludge digestion. The present normal flow of 3 M.G.D. (with peaks of 5 M.G.D.) had to be lifted 20 ft. at the plant.

L. D. Matter, Wilkes-Barre, Pa., Secretary of the Association

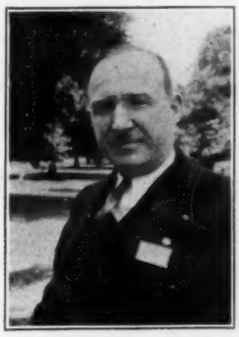
Frank Altemus, Supt. Sewage Works, Norristown, Pa.

Buffalo variable and constant speed pumps, operating in tandem with the variable speed unit automatically operating at changing speeds to meet flow changes, were used.

The Link Belt bar screen was automatically cleaned every 30 minutes, with practically no difficulty, and with high efficiency since placement of a velocity checking baffle between the screen and grit chamber beyond. From the latter the grit passed to an inverted cone type washer from which a screw conveyor discharged it. As to motor and pump operation, there had been some deterioration of copper and electric contacts due to hydrogen sulphide attack. Heating at the shaft bearings of the vertical pumps had been corrected by substituting water for grease lubrication. Mr. Altemus had found the gas-engine driven auxiliary generator set of great value in two emergency situations and he stressed the desirability of equipping plants with some form of emergency lighting system.

The Link Belt mechanism in the settling tanks (90 x 13 x 21 foot depth) had given no trouble, was inspected and greased monthly and operated 2 hours prior to the daily pumping of sludge to the digesters. The sludge pumps (400 g.p.m. cap.) had given considerable trouble until the 3 H.P. motors were replaced with 5 H.P. units. In the beginning the heated sludge digesters had given considerable trouble. The 4 inch hot water coils of C. I. pipe, supported on wall brackets, had floated up and on dropping back had

Harry Moses, Harrisburg, Pa., Official Toastmaster



F. S. Friel, Philadelphia, Chairman of Program

broken many brackets and let the piping drop. The lesson learned was to secure hot water heating pipes by strapping firmly to wall brackets. The hot water heaters had to be operated at high temperature (130° F. outlet water) to minimize stack condensation and corrosion due to sulphides in the digester gas. Every 90 days the whole heater had to be cleaned of deposits and the burners had to be brushed weekly. Sludge drying was carried out on both open and glass covered beds. When selling the sludge under glass the taker was required to remove sludge from an equal number of open beds, thereby reducing plant labor.

Mr. Altemus cited his experiences to indicate the value of a study by operators of power load distribution at sewage plants, making possible an application for a change of power factor. For example, the survey made by himself and power company representatives at the Norristown plant had resulted in an increased power factor and change of capacitator. The net benefit had been a reduction of $1,100 per year in billings for power—even in this plant where the chief use of power was for pumping only.

The annual operating budget of the plant (3 M.G.D.) was divided as follows:

Labor and Supervision	$ 8,000
Power	5,000
Insurance (Explosion, etc.)	1,000
Miscellaneous Maintenance	1,500
Total	$15,500

J. R. Hoffert, Engineer, State Department of Health, complimented Mr. Altemus on the systematic operation of the Norristown plant, and the proven value of the adequate record keeping which had led up to the power survey and the resultant savings reported. That Mr. Altemus had only to report to the Chairman of the Sewer Commission was a great help in facilitating management and operation. That he had been allowed an adequate emergency item in his budget bespoke confidence in the plant management and had already proved a wise and money saving provision in minimizing emergency damage. The routine schedules of inspection and maintenance of plant equipment, and the distribution of responsibility amongst employees, constituted a high type of management. Furthermore, the value of salesmanship was in evidence in the procuring of a flexible and ample operating budget and in sludge marketing. Mr. Hoffert also commented on the lack of attention to effective ventilation of sumps and rooms at sewage plants generally. His thought was that return of supernatant liquor to settling tanks was the chief source of hydrogen sulphide and other troubles.

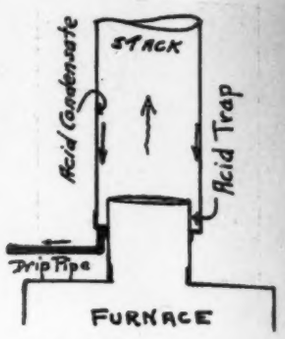
L. H. Enslow—rose to say that he had visited the Norristown plant and wished to add his compliments to Mr. Altemus on his able management and operation of the plant. He was impressed with the power study, the general improvements and the advantage of having a former utility company engineer in charge of our modern mechanized treatment plants.

In the ensuing discussion, methods of eliminating damage to furnaces from the acid produced from the sulphur in digester gas were considered. Dr. Rudolfs reported that in Berlin a scrubbing tower filled with chipped limestone had been very helpful. Mr. Hunger said that the condensation of moisture and thereby sulphuric acid production took place largely in the stack and trickled down into the furnace. A scheme (here illustrated) of a little gutter around the inside of the stack, had served to catch the acid and allow it to drip to waste. Mr. Phillips said that at Meadville they had found a larger capacity furnace also worth while.

"Experiences with Sewage and Sludge Pumping Equipment"—by *R. L. Hunger,* Engineer, Buffalo Pump Company, Philadelphia, Pa.

Amongst the many valuable pointers on pump installations given by Mr. Hunger were the following: Every care should be taken to avoid strain on pump casings due to poor support or alignment of suction and discharge lines, leaded joints or flexible mechanical joints

R. F. Hunger, Engr., Buffalo Pumps, Philadelphia, Pa.



Acid Condensate Trap for Furnace Stack

being preferred to rigid flanges. Hand holes should always be provided to give easy access to underside of impellers. To preclude vibration, bearings should be on separate supports. In vertical shaft pump installations it was best to suspend the shaft on a separate thrust bearing and flexible coupling, located just beneath the motor, and another located at the pump end to eliminate shaft whip. Oversized shafts had always proved good economy with supported bearings at 6 ft. centers to reduce bearing maintenance. In cases where eleven foot spacing had proved essential a bulged shaft (2 in. increased to 4 in.) between bearings had been used to offset tendency to shaft-whip. The shaft for the smallest pumps (4 inch) should be of 2 in. diameter and increased to 2.5 inch for 6 in. pumps. As to shaft bearings, ball bearings with grease lubrication had proved the most satisfactory. If sleeve bearings were used these should be of the split design with lubrication by oil recirculation.

As to horizontal pump units the self priming types would doubtlessly be favored in future installations. The most satisfactory types involved an independently motor driven automatic vacuum pump, and were equipped with a vertical check as foot-valve. In sludge pumping, if centrifugal units were used, it was highly advisable to provide for pre-shredding or cutting. Such was attained effectively by the types equipped with a cutting and feeding screw located ahead of the impeller.

Mr. Hunger commented that in automatic pumping operations the use of constant speed units saved power because at the lower speeds of variable speed units the efficiency was but 50 per cent increasing to 75 per cent a full load. Further, a larger suction well was required for variable speed pumps. Cutting in and out of fixed output units, in capacity sequence, was usually a less costly method of automatic pump control. In respect to pumping costs, such had been frequently needlessly high because it was a common fault of engineers to over design and specify characteristics to meet an anticipated head or capacity for some future time. It would

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1—*Jones (?), Emigh;* 2—*Young, O'Donnell (?), Hoffert;* 3—*Rudolfs, Tark;* 4—*Friel, Diefendorf, Wagner, Burnside;* 5—*Beckett, Taggart, Miller*

J. E. Goddell (Lancaster) *T. R. Komline (Plainfield, N. J.)* *G. M. Olewiler (Ardmore)*

be far better economy to select an impeller capable of meeting current requirements and in later years replace it with another to meet conditions then existing. To save water required for the water seals on pumps, an automatic Solenoid valve, opening and closing with the cut-in and cut-out of the pump motor, had a proven value. At the cost of about $15.00 such a valve arrangement shortly paid for itself in many instances.

G. M. Olewiler, Supt. Sewers, Ardmore, Pa., called attention to the value of levelling pads for lining up vertical units. To preclude strain on pump casings he preferred bell and spigot joints on intake and discharge lines. He preferred grease packed bearings to oil lubrication, and his experience was that bearings could be too large and thereby act as brakes. Cast iron impellers used in the Ardmore pumps were replaced every 5 years. By experience, since 1924, he favored horizontal pumps in a dry well under positive head, if effective ventilation could be had. *F. S. Friel* added that there was no choice but horizontal pumps whenever the head was greater than a verticle pump could operate against efficiently.

"Sludge Drying at Plainfield, N. J."—*John R. Downes,* Supt. of Sewage Works, and *T. R. Komline,* Chief Drier Operator, Plainfield, N. J.

Mr. Komline described the new process of sludge drying and equipment in use at the Plainfield, N. J., plant. The talk was illustrated by moving pictures. He explained that the digested sludge was partially dewatered by adding about 4 lbs. of filter alum (in solution) to each 100 lbs. of dry solids. The release of carbon dioxide caused a flotation of solids, the separated liquor being drawn from beneath and resultant sludge thus thickened to 10 per cent solids content. This was atomized into the heated drying chamber and fell to the floor as a dried pulverant material containing 30 per cent moisture ready for use as a low grade fertilizer or fertilizer base (4 per cent N.)—or it could be burned as fuel.

The atomization was accomplished with a high speed (9,600 r.p.m.) revolving slotted bowl. The sludge "fog" gave up its water during its decent in the drying chamber, through which heated air was recirculated at a rate of 1,000 volumes to 1 of sludge. The air temperature was thermostatically controlled, entering at 700 deg. F. at the roof and leaving 1.5 minutes later at 200 deg. F. near the floor of the chamber. The dried product (25 to 30 per cent moisture) was automatically scraped to the center floor outlet. Soft coal was used for heating the recirculated and new air input—each pound of coal used accounting for 8 pounds of water converted to steam vapor.

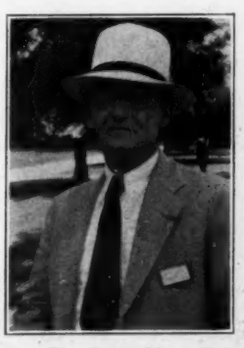
The plant had been put in by Industrial Associates, a firm which had successfully dried many other wet organic products with similar equipment. Now in operation one year, a 90 day continuous run had recently been made to establish performance and costs. At present, using the 10 per cent solids sludge, the operating costs were $12.04 per ton of dry solids turned out. Short runs indicated that with 2 per cent less water in the sludge (12 per cent solids) the cost reduced to $9.86 per ton. Also, elutriation of the sludge promised a lower chemical cost in sludge concentration. At present, $10.00 per ton was being gotten for the product from the drier. If burned, it would supply 33 per cent of the total heat required but was more valuable as a fertilizer.

To produce one ton of dry solids (1.43 tons of fertilizer) from a 10 per cent solids sludge, required (on the average) 2,804 lbs. of soft coal; 95 K.W.H. of power; 4.3 hrs. labor, and 80 lbs. of alum. From these figures the cost of $12.04 per ton of dry solids had been derived.

C. F. Wertz, Engineer, Morse-Boulger Destructor Company, Philadelphia, Pa., who had earlier been identified with the recent Nichols-Herreschoff incinerator installation at Dearborn, Mich., reported it to be burning a sludge cake of 65 per cent water content with a fuel oil consumption of only 5 to 6 gallons (some days none) per ton of dry solids. This considerably bettered expectations, the guarantee having been twice the oil requirement actually realized. On the series of hearths (shelves) the sludge gradually dried on the upper ones, was raked as it dropped to successively lower hearths and burned on the lower three. A triple pass air preheater was used on the intake. A temperature of 1,300 deg. F. had been assumed as the lowest temperature for odor destruction but actually 1,100 deg. F. had proved effective.

"Experiences in Starting-Up the Lancaster, Pa., Activated Sludge Plants"—by *John F. Laboon,* Chester, Laboon, Campbell, Bankson and Davis, Engineers, Pittsburgh, Pa.

Mr. Laboon's paper was presented by D. E. Davis, a partner in the firm. The Northside plant had been put into service in December, 1934. Screenings, grit and skimmings (grease) had been successfully incinerated at a rate of 400 to 500 lbs. per sq. ft. of grate area, whereas only half this rate had been expected. The Jeffrey mechanical bar screen had proved very satisfactory as had the settling tank mechanisms, after speeding up the rate of flight control. Oil reaching the plant had been troublesome and created frothing in the aeration tanks. Also filamentous growths had been troublesome in the final tanks but the long take off wiers at end and around the side walls had been very helpful in minimizing sludge lifting. The gas dome (holder) at the center of each digester had worked out very satisfactorily as had the power economy by using synchronous motors on the air compressors. The Chicago Centrifugal Sludge Pumps had given satisfac-



L. E. Burnside, City Engr., Sharon, Pa.

D. E. Davis, Consulting Engineer, Pittsburgh, Pa.

Harry J. Krum, Chemist in Charge Water & Sewage Treatment, Allentown, Pa.

Charlie Wertz, Engr., Morse-Boulger Company, Philadelphia, Pa.

tion and the sludge return pumps, operating on variable speed, had proved effective in returning sludge in proportion to the varying flow of settled sewage reaching the aerators.

I. O. Lacy, Chemist, New Jersey Sewage Experimental Station, New Brunswick, N. J., said that he believed every new activated sludge plant had to feel its way along, so to speak, until the most effective ratio of suspended solids to carry in the aeration tanks, and similar operating control factors, could be determined for the specific conditions at hand. He felt that more study should be given the design and baffling arrangements to prevent lifting of sludge from the bottom of final tanks during peak rates of flow. He wished he could say what was the best method of handling supernatant liquor from digestion tanks. There didn't seem to be any satisfactory answer to that question and he would admit that he would like to learn of one.

Later in the meeting, *L. H. Enslow* in commenting on supernatant liquor problems thought that in many cases the incineration of dewatered fresh sludge might be the most perfect solution because there would be no supernatant. Otherwise, the reduction of the volume and improvement of quality of supernatant was possible by effective sludge concentration *before* transfer to the digesters. Two stage digestion and the use of iron salts in the fresh sludge had created a better separation of digested solids from the supernatant liquor and resulted in a clarified low B.O.D. liquor from the second stage digester. At Phoenix, Ariz., sludge concentration had made a marked difference in plant performance. There, no chemicals other than mild chlorination to suppress septic action in the concentrating tank had been used. Probably even better results could be had by economical use of an iron coagulant to enhance thickening and subsequently clarify the digester supernatant—an effect from the iron taken in with the thickened sludge.

"Some Observations on the Chemical Precipitation of Sewage"—by *Dr. W. Rudolfs,* Director, New Jersey Sewage Experimental Station, New Brunswick, N. J.

Dr. Rudolfs informally presented some of his thoughts in connection with chemical precipitation of sewage which he had gained by observation of working plants, more especially the experimental plant at Coney Island, N. Y. It seemed that when evaluating degree of purification per dollar expended for chemicals, the economy curves were steep up to 65 per cent removals and thereafter flattened out perceptibly. Further, to boost the purification above this figure it was considerably less costly to provide effluent filtration than the extra chemicals required for an equal effect. For example, equal if not better results were obtained at $3.00 per m.g. for chemicals with filtration than at $6.00 per m.g. without filtration in the Coney Island demonstrations. On the whole a $6.00 per m.g. cost for chemicals plus filtration seemed to give the most satisfactory and at the same time economical results—70 per cent B.O.D. removal and 80 per cent removal of non-settleable solids. This all went to show that there was an optimum of purification economy in chemical treatment which it did not pay to try to exceed except in special instances. The upper limit seemed to be 75 to 80 per cent purification with chemicals, mechanical flocculation, sedimentation and mechanical straining such as was obtained with the Laughlin coarse grained shallow filter.

In reply to questions, Dr. Rudolfs said that he expected chemical treatment to compete with activated sludge when properly done. He thought a combination of chemical treatment and activated sludge might be a future consideration in some cases where maximum purification might be demanded. To such a combination a filter unit would prove of considerable value in improving or sustaining the quality of effluent.

Again replying: He had not found that ordinary chemical treatment interfered with the B.O.D. test unless the pH value was so great as to necessitate neutralization. He considered a flash mix of chemicals followed by 20 min. of flocculation justified and sufficient. In figuring the above costs he had used prices of $12.00 per ton for lime and $40.00 per ton for ferric chloride.

Wm. H. Baumgartner, Chemical Engineer, Krebbs Corp., Newark, New Jersey, who has recently left Dr. Rudolfs to undertake a program of expanding and improving the use of ferrous-sulphate (copperas) in sewage treatment, called attention to the value of returning chemical sludge to the crude sewage and precipitation of the effluent of the primary tank for raising the efficiency of chemical treatment. It was his opinion that return of sludge and aeration to obtain a type of bioflocculation prior to addition of precipitating agents was the most promising method of obtaining purification efficiencies in excess of 80 per cent at the least overall cost. (Results obtained from the Guggenheim experimental plant and also large scale demonstration at the Hagerstown, Md., Activated Sludge plant since the State College meetings would seem to support Mr. Baumgartner's opinion.—Ed.)

"Chlorination of Sewage"—by *L. H. Enslow,* New York City.

Mr. Enslow informally reviewed the now established newer uses of chlorine in sewage treatment practices briefly. More particularly did he discuss the most recent developments in which chlorination had been proven the most efficient precipitating agent of fats and proteins from meat packing wastes; as an adjunct in the operation of activated sludge plants—notably, for sludge concentration preparatory to digestion and the control of condition of activated sludge by very mild chlorination of the returned sludge. More stress was placed on what he expressed as "Indirect Chlorination,"

Chas. Young (Meadville) *Prof. E. D. Walker Pres.-Emeritus* *Frank Daniels (Harrisburg)*

wherein chlorine water passed through scrap iron in a tower to produce *ferrous* chloride and this discharged continuously to the sewer, had been proving a more efficient and economical scheme of odor control than direct chlorination. He discussed the technical reasons; the chief one being the non affinity of organic matter for ferrous iron which rendered it 100 per cent effective. Therefore, the chlorine involved became 100 per cent effective in changing volatil hydrogen sulphide to non volatil sulphide of iron. Other advantages were, the subsequent value of the iron in better clarification; the likely improved efficiency of the biological oxidation processes; beneficial effects on sludge digester operation, with clearer supernatant resulting. Exact control of such "indirect chlorination" would not be important because a reasonable excess of chlorinated-iron would prove beneficial in floc improvement, rather than harmful to the activated sludge process, whereas residuals of "free" chlorine in the settled sewage had proved deleterious at times.

In chemical precipitation the ferrous chloride solution could be as easily converted to ferric chloride, by secondary chlorination of the tower effluent, as could a solution of copperas be converted to the oxidized form of chlorinated-copperas. It was therefore plain that "indirect chlorination" in the form of chlorinated-copperas or chlorinated *ferrous chloride* would become an important factor in chemical precipitation and competitive with ready prepared ferric chloride or ferric sulphate. In odor control and sewer protection against gas attack, Mr. Enslow predicted that "indirect chlorination," involving scrap iron and chlorine, would far outdistance direct chlorination in a short period of time, but we must still depend on the latter to destroy pathogenic organisms and undesirable biological growths and also to reduce and check oxygen demands and suppress sewage degradation and putrefaction.

"Sludge Heating and Gas Collection"—by *H. L. Kinsel,* Assistant Engineer, State Department of Health, Philadelphia, Penna.

Mr. Kinsel said that apparently from 3 to 30 B.T.U. per hr. per sq. ft. of heating coil surface had been assumed in figuring coil requirements. At 80 to 85 deg. F., between 6 and 11 B.T.U. per hr. per sq. ft. of effective coil surface seemed to be the justified coefficients on the average. Much depended upon the temperature and velocity of the water passing through the coils, the rate of sludge mixing in the tank and its viscosity. He presented observed figures at several plants and had found that the degree of sludge thickening, before transfer to digesters, played an important part in heat conservation—especially in winter. Water temperatures as high as 155 deg. F. had not created sludge baking on the coils.

Difficulties with blowing oil seals of the gas domes on fixed roof digesters emphasized the value of gas holders. Without these, it had been necessary to shut off all burners and draw supernatant with care to produce about a 3 inch vacuum on the gas dome and thereafter pump in sludge to produce a 3 inch positive pressure, all of which was a nuisance.

Professor E. D. Walker, State College, Pa., said that condensate formation and consequent corrosion of heating furnaces could be prevented if output water temperature was held above 160 deg. F. and he recommended a water bypass around the boiler in order to cool the high temperature water. He advocated a separate recirculating water pump for each digester.

C. C. Agar, Engineer, New York State Department of Health, told of a scheme of running a small copper steam line through a gas line in order to prevent condensation of moisture and freezing. He, too, had found the high temperature furnace operation and water bypass of value in checking boiler and stack corrosion.

Operators' Symposium

"Sludge Dewatering Tests on Sand Beds"—By *Paul Coy,* Operator, Sewage Treatment Plant and *C. H. Young,* District Engineer, State Department of Health, Meadville, Pa.

Mr. Young, who presented the paper, reported on carefully controlled tests at the Meadville plant on open and glass covered sludge beds operated side by side from which it was concluded that the covered beds handled about 1.7 times more dry solids than open beds (71 lb. per sq. ft. as against 48 lb. yields of open beds). The sludge was well digested. In actual year round operation such high yields could not be realized and 55 lb. per sq. ft. on covered or 36 lb. from the open beds had been about the practical yields to be counted on at Meadville. The lowest solids content of sludge satisfactorily removed from the beds was 22 per cent, but only with some difficulty and tender handling. Effective drainage of "free" water from beneath the floating sludge had proved the most important factor in dewatering and drying because 68 per cent of the total water removed went away as drainage during the first 48 hours. It was the slower loss by evaporation that the glass covers assisted.

The proper depth of sludge drawings seemed to be between 7 and 16 inches on the beds and dewatering improved with slow rates of bed filling, so as to release the gas which created sludge flotation and free water release. Maximum bed yields had resulted from a regular routine sequence of sludge drawing followed by removal as soon afterward as the cake was handleable with forks. Rate of evaporation went hand in hand with the rate of drainage; in other words, with the "freeness" of the water. Highest winter yields came from shallow applications. On the covered beds, heated on the interior, a yield of 300 lb. per sq. ft. per year could be attained.

"Operating Secondary Settling Tanks"—By *S. C. Bailey,* Chief Engr., State Hospital, Danville, Pa.

Mr. Bailey related how by changing parallel final settling tanks into series operation and the addition of 0.5 grains per gal. of coagulant, and chlorinating between the two tanks, the effluent turbidity had been lowered from 30 to 12. Bacterial removal had increased and the sludge dried without nuisance on sand beds. The net added cost was 25 cents per day for the improved conditions, in which the chlorine requirement had been reduced.

"Mechanically Cleaned Primary Tanks"—By *J. E. Goodell,* Chemist-Bacteriologist, Lancaster, Pa.

Mr. Goodell reviewed the development of the mechanically cleaned sewage tanks and described the rectangular Lancaster tanks equipped with Jeffrey Company conveyors and grease skimmers. Removals through these

E. B. Swinehart (Pottstown) *J. C. Bailey (Danville)* *C. N. Lauer (York)*

units had averaged 58 per cent suspended solids and 53 per cent B.O.D. reduction. Diffused air in inlet flumes (.03 to .06 cu. ft./gal.) had assisted in grease separation, in freshening up the sewage and in equalizing flow distribution.

"Separate Sludge Digestion"—By *E. B. Swinehart,* Chief Operator, Sewage Treatment Works, Pottstown, Pa.

Mr. Swinehart described the 45 ft. diam. by 26 ft. deep dome-roofed Hardinge digesters at the Pottstown plant which treats 1.4 m.g.d. sewage flow. The mixing and scum breaking mechanism was operated 1 hr. each day following sludge transfer. Sulphide in the gas had given considerable trouble with the heating furnaces necessitating frequent burner cleanings. The sludge drawn had averaged 91 per cent water and 33 per cent volatile matter. Liming at rate of 10 lb. to each 800 cu. ft. of crude sludge had been practiced. He had experienced troubles caused by gas take-off lines being too near the scum line and too small in diameter. He recommends gas lines be of a 4 in. pipe with a scum trap near the gas dome.

"Screening Sewage"—By *Chas. N. Lauer,* Operator, Treatment Works, York, Pa.

Mr. Lauer described the automatically cleaned bar screen and screenings hammer-mill shredder at the York plant, treating 5.25 m.g.d. average to 7.25 m.g.d. maximum flows. The pulped solids did not float, and the tanks remained free of scum which previously had to be removed by skimming. Also plant operations had in other ways been improved, especially the reduced pump and valve clogging.

"Beautification of Sewage Plants"—By *L. E. Burnside,* City Engineer, Sharon, Pa.

Mr. Burnside explained that the Sharon plant, located near residences, had been beautified to minimize complaints. It now served as an example for nearby property owners. As the first in Western Pennsylvania to take up sewage plant beautification, he found nurserymen and florists glad to assist and later many donations had appeared. Mr. Burnside believed that considerable open lawn, providing vistas, was the most effective scheme. The total beautification cost had been about 0.5 per cent of the cost of the plant.

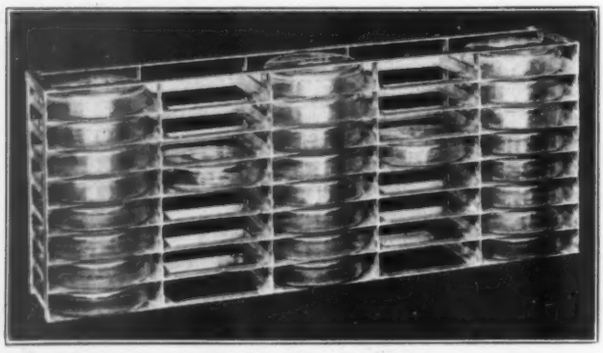
President Phillips remarked, that in Meadville the sewage plant had been the first of the utilities to beautify, but now there was quite a rivalry between the water and the sewage plants. The city had in its employ a young landscape architect who had proved his value in several ways.

1 2 3 4 5 6 7

1—P. M. Detwiler (Lansdale); 2—F. G. Diefendorf (Erie); 3—W. H. Eastburn (Phila.); 4—M. C. Fleming (York); 5—R. R. Cleland (State College); 6—A. C. Williams (Haverford); 7—Larry Morgan (Greensburg)

Improved Petri Dish Holder

By LUTHER BOATMAN and NEIL KERSHAW*



Indianapolis Petri Dish Holder

For some time there has been a need felt for a means of handling petri dishes more easily and at the same time cut down the breakage of dishes due to stacks slipping in the incubator or in the handling involved.

The idea had never taken any definite shape until recently when an advertisement of a petri dish holder was received. An apparent objection to this holder as it stood was that there would be no chance for circulation of air around the plates. Some years ago another laboratory obtained some erratic results in 37 deg. bacteria counts due to stacking their plates too closely together in the incubator. The center plates were showing low counts which were eliminated by placing the stacks farther apart. So plans were drawn for a holder which would offer several practical features.

The holder as designed is made up of an open frame work of 26 gauge stainless steel strips soldered together, leaving approximately ⅛ inch between dishes so that there can be free circulation of air. The holder consists of 5 sections of 8 shelves each to accommodate 20 mm. dishes. (This can be changed of course to any number of sections and shelves desired without interfering in any way with its effectiveness.) The dishes, after planting and setting of the agar, are inverted and slid in on the shelves of the holder from the front. The shelves, not being quite as deep as the diameter of the dishes, leave a little of each dish protruding for ease of removal—see illustration.

The holder then—(1) makes handling of dishes easier (not only for placing in and removing from the incubator, but in counting and carrying to the preparation room for washing); (2) reduces breakage due to stacks of plates sliding and breaking in incubator or in handling; (3) allows any single plate to be removed for inspection or counting without disturbing the others, and (4) gives free circulation of air around each dish so that 37 deg. C. is attained in each dish very quickly.

The fabrication of the holder was carried out by a local sheet metal works in stainless steel for $14. Fabricated from copper, the quotation was $1.50 less.

*Senior and Chief Chemists, respectively, Indianapolis Water Co., Indianapolis, Ind.

BATTERY METERS—THEIR INSTALLATION AND PERFORMANCE

By C. M. McCORD

General Superintendent
Water Department, Memphis, Tenn.

C. M. McCord

IN view of what appears to be possible advantages to be had by using a battery of three 2 inch disc meters, instead of a single compound or turbine meter, an investigation was made as to the most practical and satisfactory method of installing or piping them. To begin with, standard fittings were used to build up the two manifolds. The center fitting in each case was a cross with nipples and ells on both sides of the crosses. Between these made up manifolds, the three meter legs were built up, each leg including a 2 inch disc meter with flange couplings ahead and back of the meter, and 2 inch gate valves between the flanges and the manifolds. It was found to be a difficult job to run these three short legs in between the two fixed manifolds. Each leg must make up the same length and the alignment must be practically perfect. While it is not an impossible job, it is one that is slow and difficult. After this set-up was made it was apparent that the meter vault should be large enough to include the manifolds so that they could be inspected and repaired if necessary.

To simplify the installation, both as to fittings and labor, and to provide manifolds that could be built into the vault walls, two cast iron manifolds were made, each having a 4 inch bell inlet and three 2 inch bell outlets properly spaced for the connecting meter legs. The advantages of these cast manifolds are, first: Being cast iron, it is possible to incorporate them in walls of the vault thereby reducing the size of the vault; second: It is not necessary to set them an exact distance apart, nor is it necessary that they be in exact alignment; third: The meter legs, including meter, flanges, check valve and valves are made up at the shop and should they vary as much as an inch in length, they can be readily installed. After the manifolds have been set a measured distance apart, to install the meter leg, one of the flange couplings is taken loose, dividing the leg into two sections. One section is then placed into the bell of one manifold and the second section is placed into the bell of the other manifold. The flange joint is remade, the leg adjusted to position laterally and caulked in place with a small amount of lead wool. After the three legs have been installed in this manner, then the bell joints are poured and caulked in the usual manner. By cutting a light running thread on the 2 inch nipples that are caulked, this prevents them blowing out when a meter is removed and also makes it possible to screw this nipple into and out of the lead joint should it become necessary.

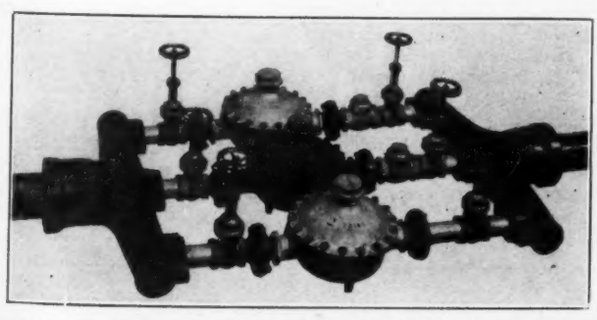


Fig. 1.—Battery Meter Arrangement Designed for Memphis, Tenn. Note special C. I. manifolds and check valve arrangement causing all minor flows to register through one meter.

In this test installation, check valves were placed in two meter legs for the purpose of protecting these two meters from hot water and to direct all very small flows to one meter only, rather than have it divide between the three. The accompanying photograph (Fig. 1) shows quite clearly the installation as made by using cast iron manifolds.

Testing for Accuracy

After developing a practical and easy method of making the installation, it was then decided that tests would be run to find out what *our* meters would do under *our* observation. Meters were taken from our shop that were pronounced ready for service. Back of the battery meters pictured, was placed a 4 inch compound meter and back of this a 4 inch turbine meter. This was a series arrangement, water passing through the three measuring arrangements and into a large scale tank, thus making it possible to readily compare the registration of each device against dead weight. Figure 2 shows the results of these tests, rate of flow being plotted on the X axis and percentage of registration on the Y axis. These curves have not been ironed out in anyway and the small circles are the actual results plotted. They may not be the curves that some might expect, but, nevertheless, they represent what happened when *we* tested *our* meters.

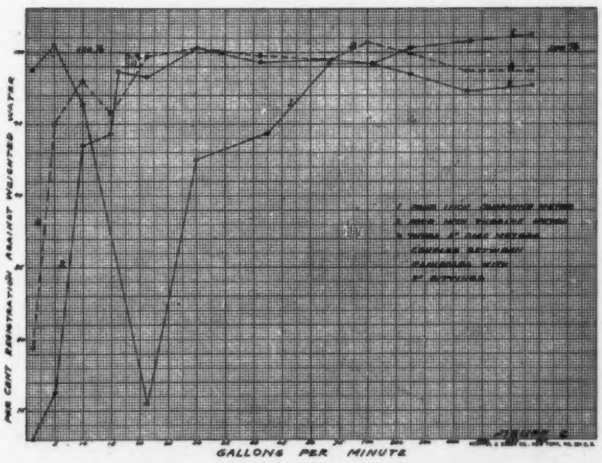


Fig. 2.—Comparison of Accuracy of Meter Registration. (Battery Meters vs. Compound vs. Turbine Meters.)

An investigation was then made to determine how the load would divide between the three 2 inch disc meters that made up the battery. Figure 3 plainly shows the result of this test. The number one meter, without check valve, took the small flow entirely and as the flow was increased it shared the load in an increasing amount with the other two meters until the flow was about evenly divided. It was also established that on removing the two check valves and operating all three meters without these valves, that one meter took the very small flows. With the checks out, first one meter and then another would register, but with check valves in two legs, the small flow was always registered by the meter without the check.

The last phase of the investigation covered the drop

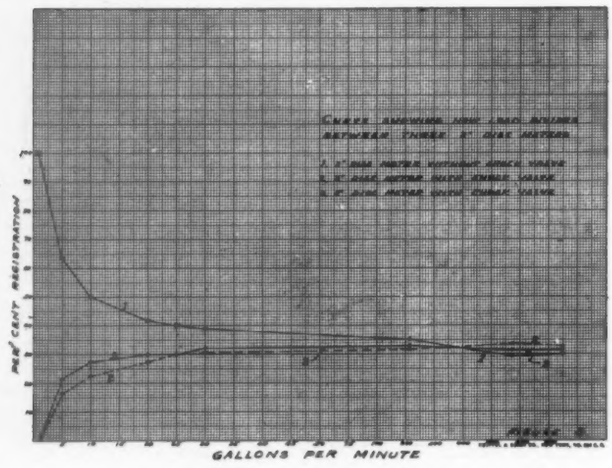


Fig. 3.—Division of Load Between Three 2-inch Meters in Battery. (Note that check valves throw all flow under 5 g.p.m. to the one meter without a check.)

in pressure. This was measured in the case of the battery meters about 2 ft. ahead of and behind the manifolds, and about the same distance ahead and behind the two larger meters. The results obtained are shown in Figure 4, which is self explanatory. After these tests were made, we piped one of the disc meter legs with 2½ inch nipples and valves, and from the figure it will be seen that the drop in pressure was not helped greatly. An examination of this data indicates clearly that different conditions and circumstances demand different methods of metering. In some cases, it may prove necessary

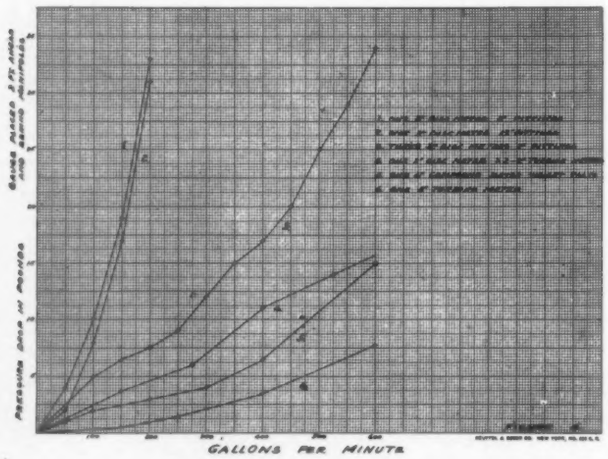


Fig. 4.—Curves Indicating Comparison of Pressure Drop Through Battery Meters vs. Other Types. (Note: Where pressure loss can not be tolerated turbine and compound type meters must be selected at the expense of low flow inaccuracies.)

to sacrifice small flow registration in favor of increased pressure. In other cases, the small flows can be picked up at the expense of loss in pressure at the larger flows. On these considerations the most desirable arrangement can be selected and the service metered accordingly.

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Association Meetings Scheduled:

July 17—**Long Island Conference Sewage Works Operators and Officials.** Lawrence, Long Island. Secretary, Lawrence Luther, Supt. Public Works, Freeport, L. I.

Aug. 22-23—**Central States Section A. W. W. A.** (Annual Meeting.) Pittsburgh, Pa. Fort Pitt Hotel, Pittsburgh, Pa. Sec'y, H. Lloyd Nelson, U. S. Pipe and Foundry Co., Koppers Bldg., Pittsburgh, Pa.

Sept. 16-18—**Rocky Mountain Section, A. W. W. A.** (Annual Meeting.) Brown Palace Hotel, Denver, Colo. Sec'y-Treas., B. V. Howe, 437 State Office Bldg., Denver, Colo.

Sept. 17-20—**New England Water Works Association.** 54th Annual Convention. Providence-Biltmore Hotel, Providence, R. I. Sec'y, F. J. Gifford, 613 Statler Bldg., Boston, Mass.

Oct. 4-5—**New York State Sewage Works Association.** Hotel Van Curler, Schenectady, N. Y. Sec'y, A. S. Bedell, State Department of Health, Albany, N. Y. (Joint meeting with New England Sewage Works Association.)

Oct. 4-5—New England Sewage Works Association. Hotel Van Curler, Schenectady, N. Y. Sec'y, F. W. Gilcreas, State Department of Health, Albany, N. Y. (Joint meeting with New York State Sewage Works Association.)

Oct. 4-5—**North Dakota Water and Sewage Works Conference.** Grand Forks, N. D. Sec'y-Treas., M. D. Hollis, State Sanitary Engineer, Bismarck, N. D.

Oct. 7-10—**American Public Health Association.** (64th Annual Meeting.) Hotel Schroeder, Milwaukee, Wis. Ass't Sec'y, W. R. Walsh, % A. P. H. A. Rockefeller Center, New York City.

Oct. 14-17—**South West Section A. W. W. A.*** Houston, Texas. Sec'y, Lewis A. Quigley, Supt. Water Works, Fort Worthy, Texas.

(*Former Southwest Water Works Ass'n.)

Oct. 14-15—**American Society Municipal Engineers and International Association Public Works Officials.** Netherland Plaza Hotel, Cincinnati, Ohio. Executive-Director, D. C. Stone, 850 East 58th Street, Chicago, Ill.

Oct. 17-18—**New York Section A. W. W. A.** Hotel Powers, Rochester, N. Y. Sec'y, R. K. Blanchard, Neptune Meter Co., 50 W. 50th St., New York, N. Y.

Oct. 18-19—**Minnesota Section A. W. W. A.** St. Paul, Minn. Sec'y-Treas., R. M. Finch, % Wallace and Tiernan Co., 416 Flour Exchange Bldg., Minneapolis, Minn.

Oct. (Third Week)—**Pennsylvania Water Works Association.** (40th Annual Meeting.) Haddon Hall, Atlantic City, N. J. Sec'y, H. F. Snow, 507 Telegraph Bldg., Harrisburg, Pa.

Oct. 23-26—**California Section A. W. W. A.** San Diego, Calif. Sec'y, J. E. Phillips, Department of Water and Power, Los Angeles, Calif.

Oct. 25-26—**Central States Sewage Works Association.** (Annual Meeting.) Urbana-Champaign, Ill. Sec'y-Treas., G. H. Radebaugh, Urbana-Champaign, Ill.

Nov. 4-6—**North Carolina Section A. W. W. A.** Durham, N. C. M. F. Trice, State Board of Health, Raleigh, N. C.

Nov. 7-8—**Virginia Section A. W. W. A.** Hotel Roanoke, Roanoke, Va. Sec'y, H. W. Snidow, State Department of Health, Richmond, Va.

Nov. 6-8—**Missouri Valley Section A. W. W. A.** Fort Des Moines, Ia. Sec'y-Treas., Earl L. Waterman, Prof. Sanitary Engineering, University of Iowa, Iowa City, Ia.

June 29-July 3, 1936—**American Water Works Association.** Annual Convention. Biltmore Hotel, Los Angeles, Calif. Sec'y, B. C. Little, 29 W. 39th St., New York City.

THE CYCLES THAT CAUSE THE PRESENT DROUGHT

By HALBERT P. GILLETTE
Member American Meteorological Society
A paper read before the Society, June 26, 1935

Synopsis

In 1914 Dr. Ellsworth Huntington found a cycle of about 155 years in tree-ring thickness since A. D. 1400. The writer has found a similar cycle in the early sequoias measured by Dr. A. E. Douglass, the earliest minimum of the cycle being 1255 B. C. Curves of moving means show that the last maximum was A. D. 1863. The cycle is a month longer than 152 years. Its next precipitation minimum will be in 1939. This cycle exists in the annual silt layers, or varves, of ancient glacial lakes, and in the time intervals between recessional moraines deposited during the last Ice Age, being strikingly displayed in the latter.

Similar investigations have disclosed a precipitation cycle of 69⅔ years, whose last minimum was in 1934. These two cycles explain the present drought and indicate that its very severe effects will persist for at least 15 years longer.

Ten other cycles, of about 2 to about 49 years, that have been found in tree-rings and varves, as well as a cycle of about 100 years, are shown in a table.

Cycle amplitudes vary periodically and are generally greater the longer the cycle.

Cycle lengths approximate a geometrical progression series whose ratio is the square root of two.

THE main cause of the present drought is a cycle of about 152 years, evidence of which will be discussed first. A cycle of this order of length was found in 1910 by Keele[1], an Australian civil engineer, who discovered good evidence of it in the flood levels of the Nile subsequent to 1736. Unfortunately he overestimated the length of the cycle by more than 12 per cent. Keele used the "residual mass-diagram method" of analysis, but the cycle is equally well shown by a curve of mean flood levels by pentades, as in Fig. 1.

In 1914 Huntington[2], of Yale, found a long cycle in tree-rings subsequent to A. D. 1400, which he called a cycle of 155 years.

In 1923 Marvin[3], of the U. S. Weather Bureau, analyzed New England rainfall by "the method of accumulated sums of departures," which is "the residual mass-diagram method" used by Keele. His departure curve shows two very high peaks 145 years apart, indicating a cycle of about that length; but Marvin did not venture to express an opinion either as to the length of the cycle or the probability of its being a real cycle. This rain cycle can be well shown without applying the accumulated departure method, as will be evident by a glance at the New England rainfall curve in Fig. 1.

The New England rainfall prior to 1804 is that given in the Journal of the New England Water Works Association, Vol. 29, pages 323-332, and relates to rainfall at Cambridge, Andover and Charleston, Mass. Rainfall from 1804 to 1817 is that at New Haven, Conn. Subsequent rainfall is that at Boston, Mass.

That this cycle is real, of large amplitude, and fairly uniform in length, is also more than suggested by the curve of ring thickness of the Arizona pines, measured by Dr. Douglass[4]. Fig. 2 shows this curve of mean ring thickness by pentades, as far back as published data go, namely, to A. D. 1392.

Upon plotting this pine-ring curve the writer became convinced that Keele had not erred in calling this cycle "the grand cycle," and that Huntington was not far off in calling its length 155 years. Upon plotting a similar curve of California sequoia rings (Douglass measurements) by decades, it was evident that when the sequoias were young the 152-year cycle was almost as strikingly evident as in the Arizona pines; but when they became more than about 600 years old they did not always show this cycle satisfactorily. The oldest ring measured by Douglass was that of 1305 B. C., but in 274 B. C. he inserted a group of young trees in his table of average ring thickness. Hence until about A. D. 300, the sequoias give excellent evidence of the 152-year cycle, as will be shown later. There is a strikingly deep valley of this cycle about 1255 B. C., and an equally striking peak about 1179 B. C.

In order to determine the dates of the valleys and peaks of this cycle with great accuracy, consecutive 30-year means were calculated both for the sequoias and the Arizona pines. This resulted in finding that the length of the cycle is very nearly 152 years and one month, and that its last peak was in 1863. Hence its next valley will be in 1939.

As a check upon the method of consecutive means and for the purpose of applying probability calculations, the parallel column, or summation, method of analysis was applied. This method consists in assuming a length for the hypothetical cycle, and in assuming any convenient date as its initial "epoch." For example, assume a cycle 7.4 years long, and an epoch date of A. D. 1480.5,. Succeeding epochs will then be 1487.9, 1495.3, 1502.7, and so on. In the first column of a table containing 7 columns, enter the dates of the successive epochs. In the second column enter the thickness of the tree-ring corresponding to the year of each epoch. In the third column, enter the ring thickness corresponding to each

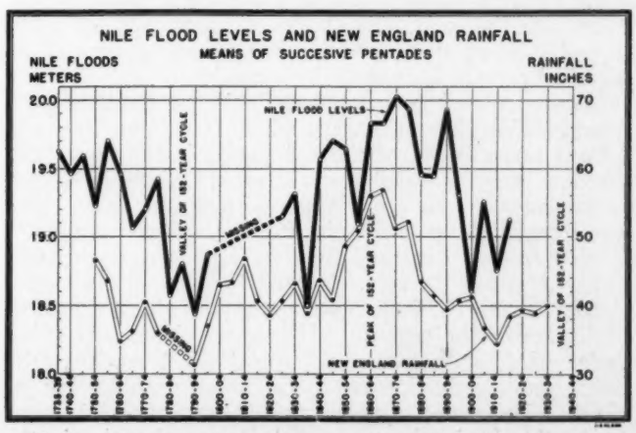

Fig. 1.—Nile Floods and New England Rainfall—Means of Successive Pentades.

year after the year in the preceding column, and so on until all the columns are filled. Total the columns in groups of 10 lines or cycles. Then compute running totals of these groups, until inspection discloses whether a fairly symmetrical curve would result by plotting the running total. Plot the curve. If it shows a peak, in, say, column 3, and a valley in column 1, there is evidence that the hypothetical cycle of 7.4 years, or one of approximately that length, may exist. Plot a succeeding running total of, say, 10 cycles. If its peak remains in column 3 and its valley in column 1, the evidence becomes strong that there is a cycle whose length differs little from 7.4 years. But if both peak and valley of the second group of 10 cycles are, say, one column to the right of those of the first 10 cycles, the cycle (if it

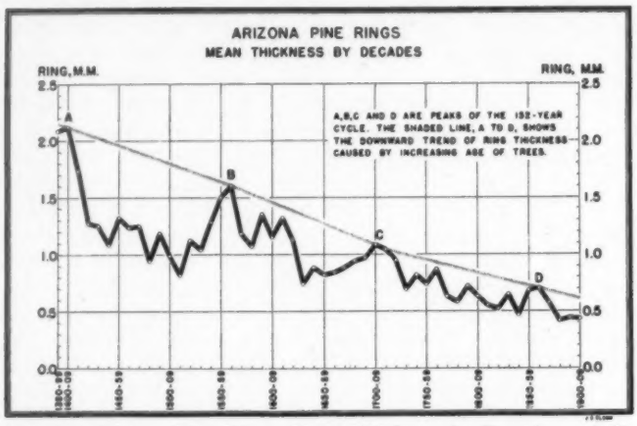

Fig. 2.—Arizona Pine Rings, Mean Thickness by Decades. A, B, C and D Are Peaks of the 152-Year Cycle. The Broken Line, A to D, Shows the Downward Trend of Ring Thickness Caused by Increasing Age of Trees.

really exists) is probably about 0.1 year more than 7.4 years. Therefore the cycle is next assumed to be 7.5 years long and a new set of epoch dates 7.5 years apart is calculated, and the tabulating process above described is repeated. By this summation process the length of a cycle is ascertainable with great precision where the available data embrace several scores of cycles. Moreover, by applying the binomial formula of probability[5] to successive groups of cycles, it becomes possible to weigh definitely the evidence for or against the reality of the hypothetical cycle. Personal opinion as to the reality of a cycle ceases to be of any consequence when the criterion of mathematical probability becomes applicable.

When the hypothetical cycle is more than about 25 years long, it saves work to use the pentade (5-year totals or averages) as the unit instead of the year, at least until the probability becomes great that the cycle is real. Then the parallel column method should be applied by years instead of by pentades.

Having totaled all the parallel columns embracing all the available data, averages of each column are calculated and a curve of these averages is plotted. Such a curve may be called a cyclograph. Since it has no resemblance to Schuster's periodogram or any other curve deduced by harmonic analysis, it seems wise to emphasize the distinction by calling it a cyclograph rather than a cyclogram. Figure 3 contains three cyclographs of the 152 1/12 year cycle plotted by pentades. Ordinates of the uppermost curve are the means of 12 cycles of Canadian varves (annual silt layers) of the Lake Timiskiming series, from varve number 167 to 1991. The varve measurements by Antevs[6, 7] were used. As the ice front receded from each point in the ancient glacial lake where the annual varves were measured, the varves became thinner. This is indicated by the slope of the broken line A B.

The middle cyclograph is one of 10 cycles of sequoia rings, from 1305 B. C. to A. D. 216. The broken line C D also slopes to the right, because the mean thickness of tree rings decreases as the tree grows older.

The lowest cyclograph is one of 3 cycles of Arizona pines, from A. D. 1410 to 1866. Dr. Douglass[4] has measured Arizona and New Mexico pine rings back to A. D. 700, but has published only those subsequent to A. D. 1391. The prediction is ventured that the 700 years of unpublished pine-ring measurements will disclose not only the 152-year cycle, but the other 12 cycles given in Table I.

The amplitude of the 152-year cycle was probably a maximum in A. D. 1711 and a minimum A. D. 799 and again 1026 B. C. The reasons for this inference will be given in a later paper.

Cyclographs of the Antevs[8] varves in Connecticut River valley likewise disclose the 152-year cycle, but even more impressive evidence of its existence is to be found in a series of 14 recessional moraines in the Berkshire Hills that drain into that valley. Taylor[9] has mapped these 14 moraines, of which 5 are shown in a map by Antevs in "The Recession of the Last Ice Sheet in New England."[7] This map shows that the rate of retreat of the ice sheet across the 50 miles of Massachusetts was about 40 years to the mile. Hence the average 4-mile spacing from center to center of Taylor's 10 moraines indicates a weather cycle of about 160 years. Taylor states that the average spacing of the 14 moraines in the Berkshires is 3.5 miles center to center. This would indicate a cycle of about 140 years. Hence it is clear that the cycle that caused these moraines is of the order of 140 to 160 years.

Alden[10] has mapped the centers of glacial deposits in eastern Massachusetts and has found an average spacing of 3.3 miles, or slightly less than the spacing of the Berkshire moraines in western Massachusetts. Hence there can be no doubt as to the substantial accuracy of Taylor's measurements. As the Ice Age waned the rate of retreat of the ice-sheet became more rapid. Antevs[6] shows that the retreat rate was about 11 years to the mile from the southern end of Lake Timiskiming, Canada, to a point about 110 miles to the north. In that region there are several deposits of glacial till spaced at intervals that indicate a cycle of about 150 years. While these Canadian halts are not all as definite as those shown by the Berkshire, Mass., moraines, they furnish excellent confirmation as to the existence of a cycle of great amplitude and of a length differing little if at all from that in the Berkshires.

Antevs[8] reprinted a chart by Sauramo showing rates of retreat of the ice-sheet in Finland. Four halts, or very slow recessions, of the ice-sheet, led Sauramo to infer a cycle of 155 to 175 years. The length of this cycle can not be very accurately determined from a few such halts of the ice-sheet, for there are other cycles, as will be shown later, that affect the length of each halt. There is, in fact, only one accurate method of determining the length of such a cycle during the Ice Age, namely, the application of the parallel column method to varve thicknesses, as above described. That method, as shown in Fig. 3, indicates a cycle length of 152 years.

Incidentally it discloses that the thickness of the varves, both in the Connecticut Valley and in Canada, tends to be greatest near the times that recessional moraines or till-beds were deposited. This proves conclusively that the thickness of the varves is more de-

pendent upon snow precipitation during the cold season than upon the length or warmth of the following summer. It also explains the occasional existence of abnormally thick varves—"giant varves." They did not result from the bursting of ice-dams, and therefore are not "drainage varves." They were evidently caused by the rapid melting of newly fallen flocculent snow, resulting in a sudden runoff that had great erosive power. Torrential warm rains doubtless were factors. It follows that the variations in varve thickness are mainly due to annual variations in precipitation. Hence the annual varves, like tree-rings in arid regions, serve as rough "rain-gages," by the aid of which the length of every weather cycle of greater length than a year can be determined with precision.

Nature's "rain-gages" roughly record annual rainfall variations over periods of time so much greater than man has recorded weather that they furnish, by all odds, the best data for solving cycle problems.

Moraines, till-beds, boulder-trains and drumlines are not the only geological records of weather cycles. Among the most striking are a series of ancient lake beaches or terraces, like those of glacial lakes Agassiz and Algonqin. The vertical spacing of such terraces is often so regular as to indicate a cycle of nearly uniform length. A study of several such series has led to the conclusion that the cause was a series of peaks of the 152-year cycle, during which precipitation increased and temperature decreased. Increased vertical circulation of the air during protracted periods of heavy rainfall lowers the temperature.

Recent drought conditions led Kincer[11] to study the trend of temperature in America and elsewhere. By using successive 20-year means, he was able to show that the temperature trend has been upward for about 70 years. This points toward a cycle of at least 140 years.

Following Kincer's investigation, Gray[12] showed that precipitation in California has had a downward trend since about 1865.

Carter[13] has shown a similar trend in the Pacific Northwest. In Fig. 2 the writer shows a similar trend in New England rainfall and in Nile floods. The New England rain peak was in 1863 and the Nile flood peak in 1869.

According to Murdoch[14] the precipitation at Salt Lake City, Ogden and Corinne, Utah, was a maximum in 1867, and Great Salt Lake was then higher than it had ever been. A 6-year break in the record of the lake levels follows, but subsequently the lake level decreased until the lowest level on record occurred in 1934. Similarly the Great Lakes reached their lowest recorded level in 1934, after nearly 50 years of downward trend. Lake George in Australia was at its highest level in 1875 according to Keele[1] and thereafter declined for many years until it went dry. Keele also adds that when New South Wales was colonized in 1788 a drought was in progress and did not let up in the least till 1795. It should be noted that a valley of the 152-year cycle was in 1787. This fits the great Australian drought that was in full swing in 1788 and was unabated till 1795. Since the severest periods of a drought due to the 152-year cycle usually last about 30 years in semi-arid regions, those Australian colonists probably experienced only the latter part of the drought. This inference is also justified by the fact that the Spanish mission padres have left records showing a drought in California that lasted from 1781 to 1810.

A report by Lynch[15] on California rainfall since 1769 was published in 1931. This interesting document contains crop records kept by the mission padres from 1769 to 1832, from which Mr. Lynch was able to derive a rainfall curve that is probably not far from the truth.

Regarding the 29-year California drought Mr. Lynch says:

"In 1781 began a period of rainfall shortage that lasted with only occasional interruptions until 1810. The total rainfall deficiency in this period was as great as any of which we have record. Some of the other droughts have been more accute, but of lesser duration. The extent of this drought is told in crop reports and in many references to the character of the seasons. It is also confirmed by a reference to the condition of Lake Elsinore, which in 1810 was little more than a swamp about a mile long. The drought was state-wide and all of the missions experienced the same difficulties."

Using the parallel column method of cycle analysis, above described, a painstaking search was made for cycles from 2 to 200 years in length. Tree-rings and sedimentary varves were the data most relied upon for evidence, but rainfall and temperature records were also used. Table 1 shows every cycle found in this search, namely 13, with the exception of some cycles shorter than two years.

It should be noted that either the parallel column method or the Schuster periodogram method is apt to yield a pseudo-cycle whose length is half that of the real cycle. This arises from the shape of the cycle curve. So when an apparent cycle is found, a search for one of double its length should always be made.

The so-called 2-year cycle has long been known. It is best seen in the varves. A study of 2-year oscillations in varve thickness finally disclosed that this cycle usually was most noticeable at intervals of 35 years or integral

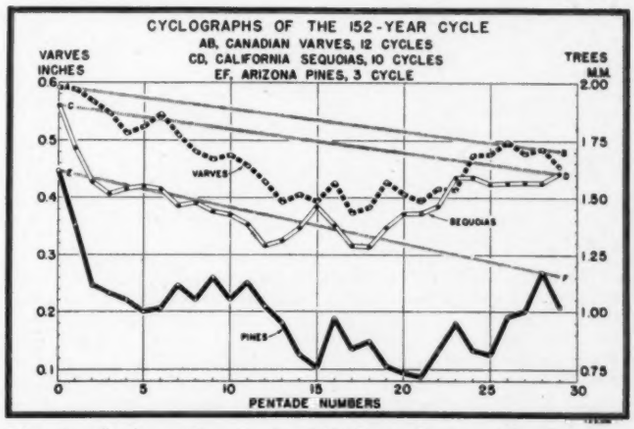

Fig. 3.—Cyclographs of the 152-Year Cycle, AB, Canadian Varves, 12 Cycles; CD, California Sequoias, 10 Cycles; EF, Arizona Pines, 3 Cycles.

multiples of 35 years. From this it was inferred that the amplitude of the 2-year cycle waxes and wanes periodically. By means of temperature and rainfall data its length was found to be 35/18 years or 23⅓ months. That it is exactly this length is indicated by its recurrence in the varves at intervals of 35 years, or integral multiples thereof, for more than 2,000 years.

Clayton[16] had previously found that his so-called cycle of 7.5-months varies in amplitude in a period of about 11 years. He attributed this variation to the Schwabe sunspot cycle. The writer has found that this cycle is exactly 11/18 years or 7⅓ months in length, and that its amplitude cycle is exactly 11 years and has no relation to the great sunspot cycle. Several

other cycles whose lengths are integral multiples of 1/18 year have been found, as shown in Table 1. These are followed in the table by a series of cycles whose exact lengths are an integral number of months. The longest of these is the cycle of 152 1/12 years, or 1,825 months. Reasoning by analogy, since the amplitudes of the shorter cycles vary periodically, it was inferred that the 152 1/12-year cycle has an amplitude cycle of 1,825 years. Evidence of the correctness of this inference is to be found in groups of exceptionally high recessional moraines at intervals of about 1,825 years. Without lengthening this paper too much, it is not possible to present the evidence that the 152 1/12-year cycle has its maximum amplitude every 1,825 years.

Table 1 shows that the mean amplitudes of a cycle is usually greater the greater the length of the cycle.

Study of the lengths there given indicates that they increase approximately in a geometrical progression series whose ratio is the square root of two. This is only an approximate law, somewhat resembling Bode's[16] law of planet distances from the orbit of Mercury. In Bode's approximate law the geometrical progression series has a ratio of two. His law fits quite closely every large planet from Venus to Pluto, excepting Neptune. It seems to the writer to indicate the existence of a series of electron-shells encasing the sun, in each of which a large planet was formed. If weather cycles are caused by magnetically gyrated electron-shells that encase the earth, and if those shells follow a doubling distance law like Bode's, then it can be shown that their periods of gyration should approximate a geometrical progression series whose ratio is the square root of two. For an outline of the gyrating electron-shell theory of weather cycles the reader is referred to a recent article by the writer[18].

TABLE I—THIRTEEN RAINFALL CYCLES

Basic Cycle, Years	Mean Amplitude, Per Cent	Amplitude Cycle, Years	Rainfall Maximum, A. D.
35/18	4	35	1911
19/6	6	19	1900
4 1/9	7	37	1922
5 13/18	6	103	1919
7 5/9	6	68	1921
13 11/12	8	167	1816
18 5/6	11	113	1889
23 5/6	12	143	1859
39 2/3	10	119	1921
48 5/6	12	293	1756
69 2/3	15	209	1760
100 2/3	13	302	1912
152 1/12	25	1825	1711

Footnote: The mean amplitude is the percentage departure of the cyclograph peak or valley from the mean. Cyclographs were those derived from Arizona pines (1391-1910) except for the 100 2/3-year cycle, for which early sequoias were used; their cyclographs usually have amplitudes about 2/3 those of the Arizona pines; hence the 13 per cent should be increased about one-half. The amplitude varies periodically through the cycle in the third column. The last column gives a date when a peak of the basic cyclograph had its greatest amplitude, and is to be used as an "epoch" date.

A cycle of 69⅔ years is shown in Table I, having its last maximum rain peak in 1760. Its last peak was in 1899, but not at the time of greatest amplitude. This cycle has assisted the 152-year cycle in causing the recent drought, and will continue to assist it for many years. Pervilief[19] found clear evidence of a cycle of about 70 years in the organic mud of Sakski Lake in Crimea where varves are now forming. He called it a 70-year cycle.

Streiff[20] speaks of having found a cycle of 60 to 90 years in length, averaging 73 years. But there is no such range in the length of any cycle. In fact the evidence of the trees and varves points clearly toward a practically constant length of each cycle.

Tree-ring and varve cyclographs made by the writer show the length of this "70-year cycle" to be 69⅔ years, and the amplitude to be great. Its amplitude-cycle is 209 years, with its next peak in 1969. Hence the amplitude of its valley in 1934 was as great as ever occurs.

With two cycles (152 and 70 years) of such a great amplitude having almost coincident valleys, the extreme severity of recent drought years is understandable. Peaks of shorter cycles will effect relief from the drought, but only for short periods. Hence it will be a waste of public funds to plant the proposed shelter belt of trees from Canada to Texas. The seedlings will never reach maturity. Similarly reforestation projects will be failures.

Crop curtailment will be a dangerous agricultural policy for many years to come.

The water supply of many cities will continue to fall short of the needs, unless steps are taken both to effect an increase of supply and to reduce wastage by metering.

Many hydroelectric power projects will fail to deliver the power that they are expected to deliver; and not a few irrigation projects will suffer severely.

We are in the middle of one of those long dry periods so often mentioned in history, which in olden times caused famines, migrations and wars. Averaged by decades, rainfall in general will be subnormal for about 40 years. The data in Table I should facilitate the determination of the ups and downs of the precipitation curve during that time.

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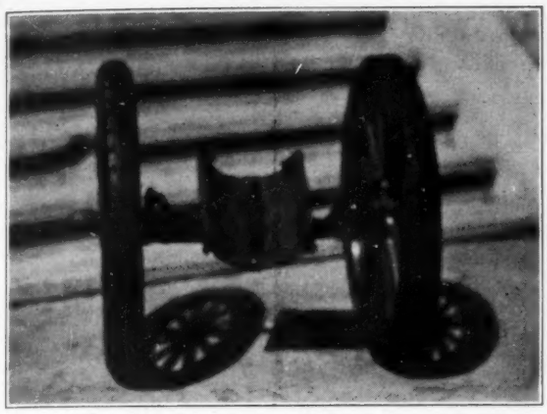
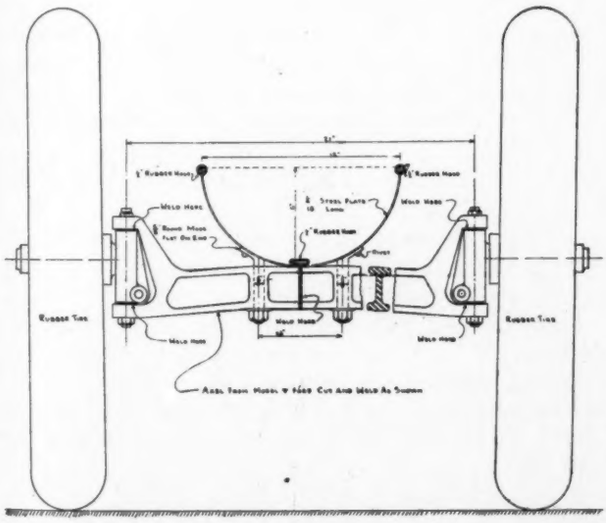
Safety Cylinder Handling Carriage

The accompanying pictures and detail sketch illustrate a novel, efficient and inexpensive carriage for transport of cylinders containing chlorine, ammonia or other compressed gases.



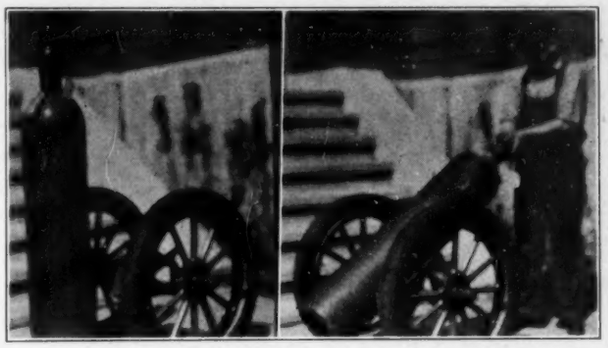
Model "T" Cylinder Carriage

This device was designed and constructed from the wheels and front axle of what was once a Model "T" Ford automobile. Its ease of handling is self evident and its use saves many a "weak back" and avoids dangers of injury to the "strong men" around water and sewage plants.



Unique Carriage Designed for Cylinder Handling at the Water Purification Plant of the Philadelphia Suburban Water Co.

To Edward J. Jenkins of the Philadelphia Suburban Water Company, Bryn Mawr, Pa., we are indebted for the illustrations of this unique cylinder truck which was developed in the above plant under his supervision.



In Position *Ready to Ride*

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Construction Equipment Association

(*Continued from page 274*)

North Michigan Ave., Chicago, and is proceeding rapidly with its work. Following are quotations from a statement issued by it on Aug. 8:

"The plan contemplates the affiliation of the membership of all existing trade associations and organized groups of manufacturers in the Industry, and individual manufacturers not so organized, with the proposed Construction Equipment Association, and that a close affiliation shall be established with the Associated Equipment Distributors. It is hoped that the restrictions to membership in the A. E. D. will be so modified that all vendors of construction equipment may become members of it and thereby become affiliates of the proposed Construction Equipment Association."

"The cost of membership in the proposed association shall be kept at a minimum, and shall be set forth in a budget which will be submitted to the membership before final adoption. It is contemplated that the cost shall not be burdensome upon any member."

Among the announced objects of the Construction Equipment Association are:

"To set up fair methods of competition as far as laws will permit, which are fundamental and applicable in all parts of the Industry but which do not conflict with Fair Trade Practices approved by an existing Trade Association or organized group in the Industry, and to afford a place where complaints alleging violation of such fair trade practices may be filed by members of the association or its affiliated distributors."

"To act in the arbitration of differences which may arise between members of the Industry or its affiliates."

"To act as a clearing house for the interchange of credit information maintained on a voluntary basis and available to all members of the Industry or its affiliates."

"To collect information, gather statistics, and work out analyses when required."

"To conduct a campaign of education among members of the Industry and the affiliated distributors with the object of procuring voluntary adherence to fair methods of competition without the necessity of resorting to compulsory methods."

"To defend the Industry and any of its component groups or affiliations from discrimination or aggression, and to encourage legislation which will tend to improve conditions in the Industry, and to oppose any legislation found detrimental thereto."

"To cooperate in improving the relations between the manufacturers, distributors and consumers."

EDITORIAL

Are We Looking Ahead?

IN this issue appears an article on "The Cycles That Cause the Present Drought" by Halbert P. Gillette. The principle cycles to which Mr. Gillette refers comprise one of 152 years, which he predicts will reach its maximum dryness in 1939, and one of about 70 years whose maximum was in 1934, "the driest year on record" in certain regions.

In his study of long cycles, Mr. Gillette has relied mainly on the evidence furnished by tree rings and the annual layers of silt (varves) in ancient lakes. These nature-kept records need not be considered as exact rain-gages, but they do show, with a fair degree of certainty, the ups and downs of rainfall curves. Moreover, they show them for thousands of years, whereas the oldest of man-kept records of rainfall, namely, that at Paris, goes back only 246 years. In America the oldest rain-gage record is one at Charelston, S. C. It dates from 1738, but is lacking in continuity. The oldest American record which is almost unbroken begins in 1749 near Boston. The oldest on the Pacific Coast starts in Sitka, Alaska, in 1842.

There are relatively few rain-gage records in the entire world that are more than a century old. Hence, man-kept records are not very satisfactory for showing other than the short rainfall cycles. Mr. Gillette has found, in the tree rings and in varves, 13 cycles ranging in length from 2 to 152 years. One of the most impressive parts of Mr. Gillette's article is that in which he gives geological evidence of the 152 year cycle.

Since the dry effects of the present cycle will apparently be severe for another 20 years, not continuously but at frequent intervals and therefore cumulative in effect, Mr. Gillette urges that more attention be given to water supply betterments and conservation. In addition to the benefits from the metering of water, which he strongly advocates as an economic and conservation measure, future plans looking toward increasing and strengthening existing supplies of water are urgent where water shortage has been felt in the recent past and where growth of populations are to be anticipated. Especially important is this matter at this particular time when air conditioning in homes and offices as a general practice is rapidly approaching.

Obviously a dry spell due to such a long cycle as one of 152 years, or even one of 70 years, is not short lived. Other shorter cycles may bring relief but such relief, based on predictions, will be but temporary. The wet spring in the Mississippi Valley has occasioned many editorials voicing the belief that the drought is over. It is over—for a few months, or perhaps a year or so—but a downward trend in rainfall that has extended over two or three generations cannot be expected to change its trend so suddenly as to jump back to a long continued normal precipitation in less time than was involved in the long descent to subnormal.

Water is to man and beast the most important provision of Nature. It should be available in ample quantity and acceptable quality at a cost within the reach of both rich and poor. It should be sufficiently abundant for its ample use in beautification of the city's home (lawn and garden sprinkling); for air-conditioning and comfort. Conservation of water supply by preventing wastage is a prime requisite of economics and common sense. This involves effective meterization. Curtailment of water supply, because of lack of foresight in advance planning, must be considered in general as being inexcusable and will not be tolerated by the public in the future. It behooves us in the water supply business to look further into the future and avoid a deficiency of supply which will necessitate any unpardonable curtailment of free but judicious use of so essential and utilitarian a product as water. To insure such conditions and secure a growing recognition from the public of the true value of water supply to communities, planning done well into the future and an educational campaign of selling the voters should be the chief immediate consideration of all water supply managers and engineers. If Mr. Gillette's theories are as sound as they seem, time of action is already at hand if we expect to avoid (in the ensuing 20 years) a serious situation which none of us wish to face.

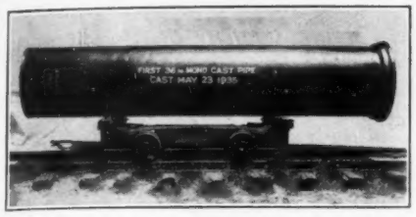
Meters are as essential in water distribution as are meters on other products of public service enterprise. In addition, they do prevent waste and render water service equitable, but they do not reduce demand characteristics sufficiently to negative the basic necessity of providing amply for peak load requirements. To this end it behooves worthy managers to look to more adequate pipe line and main capacities, to necessary pumping facilities, and to effective distribution of storage. The latter will more than enhance the fire protection—it will assure "the man who pays" a free and equitable use of water when and where it serves the maximum good to individual and community. Water supply is the No. 1 utility. Those who are responsible must appreciate this sufficiently to be able to sell the idea of betterments for the future, as well as the present, to the bond voting element of the community. In this the local press is not to be overlooked and the good-will of the community is essential.

Hand in hand with anticipated water supply deficiencies goes the matter of needed expansion in sewage and industrial waste treatment to avoid the increased seriousness of pollution which is in evidence during periods of low dilution afforded by streams. Experiences of communities in the Ohio Valley, during recent years of deficient stream flow, supplies ample proof that planning for sewage treatment is in effect planning for improved water supply. That there is ample water in a source of supply is one consideration—the percentage of the fluid that is not water is another. The next 20 years will see water supply and sewage disposal planning closer together.

NEW EQUIPMENT AND LITERATURE

Acipco Plant Making 36-Inch Mono-Cast Centrifugal Pipe

The American Cast Iron Pipe Company, Birmingham, Alabama, had added 36-in. diameter pipe to the range of pipe sizes produced by the Mono-Cast centrifugal method. All the necessary equipment has already been installed in the Acipco plant, and several orders have been booked for the 36-in. size.



The First 36-in. Mono-Cast Pipe.

The manufacture of Mono-Cast centrifugal pipe on a commercial basis began in 1924; and for several years this pipe was made only in the smaller sizes. However, due to the demand for Mono-Cast pipe in large diameters a new shop was built in 1931, for the manufacture of this product in sizes 14-in. 16-in., 18-in., 20-in., and 24-in.

▼

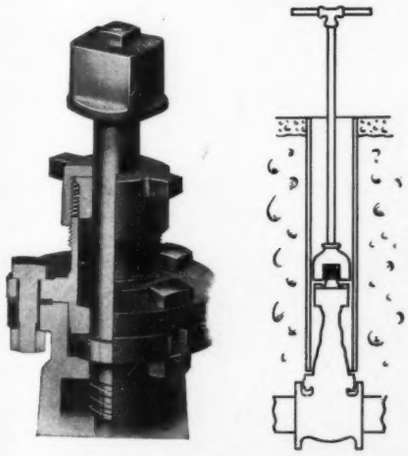
Ludlow-Coster Stuffing Box

Maintenance of Ludlow valves has been greatly facilitated by adaptation of the Coster patented stuffing box, which the Ludlow Valve Co. has been licensed to produce. With its extra deep packing and simplified method of compression, the bug-bear of leaky stuffing boxes on gate valves is practically eliminated.

An added advantage (illustrated) is that of being able to tighten packing from above or without digging to get at the valve. With a long handled, slotted key-wrench the packing unit (with projecting lugs) is tightened through the valve shut-off box as easily as is the turning of the valve stem. The extra depth of packing in the stuffing box insures a tight box for many years without need of repacking.

Ludlow valves now come equipped with the Coster stuffing box. For equipping existing valves, the bolted type Coster stuffing box may be purchased separately for the larger units. On valves used for compressed air or gas lines, Ludlow also supplies the deep packing Coster stuffing box.

For descriptive folder address Ludlow Valve Mfg. Co., Troy, N. Y.



Coster Stuffing Box and Diagram Showing Method of Tightening Packing

▼

The De Luxe "Handee" Electric Tool

The Chicago Wheel & Manufacturing Co. offers the de luxe "Handee" grinder, which is highly adaptable as a general utility electric tool for shop and repair truck tool-box. Weighing but 12 ounces, easy to hold and making use of a complete array of attachments renders it adaptable to a multiplicity of uses and for reaching difficult-to-get-at parts of equipment and machinery. In meter repair shops it is especially useful, and the drill, grinder, wire brush and polishing bits are quickly interchangeable. The "Handee" tool operates on 110 to 120 volt A.C. or D.C. circuits and is in reality a pocket edition in size and weight and has been dubbed "the tool of a thousand and one uses." For illustrated descriptive folder and prices address Chicago Wheel & Manufacturing Co., 1101 W. Monroe St., Chicago, Ill.

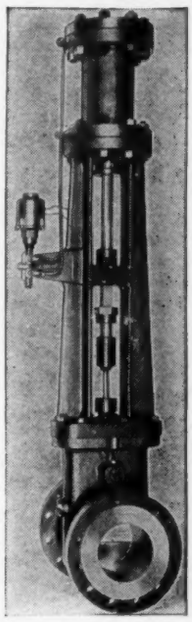
The De Luxe "Handee"

▼

Bailey Automatic Adjustable Orifice

An adjustable orifice which automatically shifts its position in accordance with major changes in rate of flow, is a new development of Bailey Meter Co., Cleveland, Ohio. This device greatly widens the flow range which may be accurately covered by standard Bailey fluid meters.

The new "Bailey Automatic Adjustable Orifice" is similar in appearance to a hydraulically operated gate valve. The "gate" is a sharp edged orifice segment, for which coefficients have been accurately determined and the position of which varies the size of the orifice opening. Adjustable stops limit the stroke of the hydraulic piston so that the orifice segment rests in one or the other of two definite positions. The piston which sets the orifice is actuated by a solenoid operated valve, commanded by contacts made in the recording meter.



New Bailey Adjustable Orifice

When the differential pressure across the adjustable orifice reaches a predetermined minimum or maximum, a contractor within the meter casing energizes the solenoid valve and automatically changes the orifice opening to correspond with a new capacity. Simultaneously with this change the integrator drive is shifted to accurately measure the total flow regardless of the orifice position. At once an auxiliary recording pen goes into operation.

Under an increasing flow condition the orifice shifts position at a higher rate of flow than it does during a decreasing flow condition. This overlap prevents constant shifting of orifice position when conditions are such that the flow holds closely to the changeover point.

▼

Harry A. Faber Now on Staff of Chlorine Insttiute

Mr. Harry A. Faber has recently been appointed assistant sanitary engineer of The Chlorine Institute, Inc., New York, N. Y., vice W. M. Bingley resigned. Mr. Faber is a graduate of Cornell University, 1930, and was formerly in the employ of Consolidated Water Co. of Utica, N. Y. He has also been employed as a consultant in water problems. The Institute is carrying on its tenth year of research in the chlorination of sewage, industrial wastes, and related matters under the technical direction of Mr. L. H. Enslow.

Catalogs and Trade Literature Received

"Flow of Fluids in Pipes" and "Heat Transmission" — Prepared recently by Crane Company's engineering department, this 84-page book of engineering data, tables and curves constitutes a valuable contribution to the field of hydraulics and heating. The foreword explains that Crane Company's engineers assembled and prepared the material in order to make available a complete summary of information required in dealing with the two important subjects covered. Much of the data are original or confirmed data from researches conducted by Crane's engineering staff. Pressure drop through pipes; orifice flows; friction losses through valves, fittings, etc.; determination of proper pipe sizes and heat transfer and heat losses through pipe and tank walls are some of the major topics discussed and formularized, with curves accompanying. Everyone dealing in hydraulics, involving pipe lines, large and small, will appreciate this valuable reference and data book. Ask for Technical Paper 405—"Flow of Fluids in Pipes, Eac." Address Water Works Department, Crane Company, 836 S. Michigan Ave., Chicago, Ill.

"Flocculating and Mixing"—The Dorr Company bulletin bearing this title is an attractive and instructive booklet of 15 pages which describes modern methods of mixing and flocculation practice and the construction and operation of Dorrco flocculators. Results from their application, in contrast with old-style mixing operations, are also given. The booklet cites data to show the marked savings in coagulating chemicals which have resulted from the modern mechanical conditioning of raw waters and sewage. It is well and copiously illustrated and worthy of a request for Bulletin 6951—Dorr Co., Inc., 247 Park Ave., New York City.

Flow Recorders and Rain Gages—Two booklets put out by Friez & Sons of Baltimore, Md., describe and illustrate the improved Friez water stage recorders for stream gaging or measuring and recording of flows of water and sewage at treatment plants or elsewhere. Friez instruments, long made for the U. S. Weather Bureau and Geological Survey, are widely used and well known, but the newest features (illustrated) make the booklet worth asking for. The second booklet describes and illustrates the several types of rain and snow gages produced by Friez & Sons, with modern improvements. Several forms of automatic self-recording precipitation gages are featured as well as methods of transmission of records from remote locations to a central point. For either or both booklets address Friez & Sons, Central Ave., Baltimore, Md.

Tru-Test Sewage Sampler—The Chicago Pump Co. has issued an attractively illustrated bulletin describing the several models of Chicago's Tru-Test samplers for accurately taking representative samples of sewage and effluents at various points at treatment plants and in exact proportion to the flow. The samplers come in stationary or portable models, with manual or automatic control features. They operate in connection with flow meters, wier chambers, syphons or changing channel velocities. The new bulletin is attractively and expensively done in silver and "Chicago Pump" blue. Other Chicago equipment is also pictured and Bulletin 128-G is worth asking for—even if just to look at. Address Chicago Pump Co., 2336 Wolfram St., Chicago, Ill.

Automatic Valves — Golden-Anderson Valve Specialty Co.—producers of specialty and automatic control valves for 30 years—present a new and complete catalog of 63 pages which describes and pictures their altitude, reducing, relief, check, float, non-return, automatic control and other Golden-Anderson specialty valves. Typical applications are sketched and engineering data are given. The producers say in effect: "If you don't find what you need, just ask for it." They invite special and tricky problems. The new catalog, No. 25, should be in every engineer's file. Write for it. Address Golden-Anderson Valve & Specialty Co., Fulton Bldg., Pittsburgh, Pa.

Hills-McCanna Lubricating System—Hills-McCanna Co. of Chicago, for 35 years makers of lubricating equipment, have just issued a new bulletin describing their lubricating and greasing systems and appurtenances. A feature is the visibility of oil flow which assures the operator that the positive and continuous flow, under piston pressure, is being had at all times. The equipment is fully described and illustrated. Address Hills-McCanna Co., 2349 Nelson St., Chicago, Ill.

Phipps-Bird Solution Feeders—A recent brochure which describes the Phipps-Bird chemical solution feeders contains an engineering description of the equipment with clearcut sketches to illustrate parts, their operation and practical adaptations of these corrosive-proof feeders for chlorination, coagulation of water and sewage or sludge conditioning practices. The claims stressed are accuracy, resistance to the most corrosive liquids, non-clogging features, low initial, operating and replacement costs, simplicity. This brochure constitutes a ready reference to methods of applying chemical solutions under a variety of conditions. For a copy of "Engineering Data on Phipps-Bird Solution Feeders" address Phipps & Bird, Inc., 915 E. Cary St., Richmond, Va.

"Dresser Couplings"—A folder of this title has just been received from the S. R. Dresser Mfg. Co—for 40 years producers of rubber gasketed flexible joints for water mains. It describes in detail and illustrates Dresser flexible couplings, expansion joints, sleeves. Also methods of installation and a variety of applications in pipe line construction and repair projects are described and pictured. This easily read booklet should prove interesting and of value to superintendents of water works and sewerage and to engineers. Ask for Form 355. Address Water Works Department, S. R. Dresser Mfg. Co., Bradford, Pa.

"Turn Your Sludge to Profits" — A folder bearing this slogan of Royer Foundry Co. of Kingston, Pa., tells how it's done with a Royer sludge disintegrator and blender. These compact utilitarian little gopher-like sludge shredders (in five models) are described and illustrated as is their method of operation on sludges—dried or half-dried. All sewage works operators and engineers will be interested in this folder. Address C. G. Wigley (Sales Agent), 3108 Atlantic Ave., Atlantic City, N. J.

"Ni-Resist"—A brochure from International Nickel Co. describes the composition, qualities and applications of the corrosion-resistant and wear-proof cast-iron - copper - nickel - silicon alloy ("Ni-Resist") in sewerage and sewage treatment practice. A graph of results from corrosion tests shows it about on a par with the more costly monel-metal. For a copy of "Ni-Resist in Sewerage Practice" address Sanitation Department, International Nickel Co., Inc., 67 Wall St., New York City.

Hellige Testing Equipment—The new illustrated bulletin of Hellige apparatus and equipment for analyses and testing catalogs Hellige products of interest to water and sewage plant operators and laboratory directors. Featured are the new compact Hellige Simplex tester for pH values, residual chlorine, etc., and the Hellige Turbidimeter, which may also be used for rapid sulphate determinations. From the pocket comparator, for field work, to elaborate laboratory apparatus, with a variety of glass disc standards and indicators, the catalog is complete. Ask for Bulletin No. 612. Address Hellige, Inc., 179 E. 87th St., New York City.

Solenoid Valves — Automatic Switch Co.—pioneers in the development of solenoid (magnet operated) valves for automatic or remote control—offer a 24-page catalog of their valves of this type for a variety of conditions. "Asco" valves of the packless type are featured. The growing use and special adaptation of solenoid type valves in water works and sewerage practice renders this new catalog of especial interest. Ask for "Asco Solenoid Valves." Address Automatic Switch Co., 154 Grand St., New York City.

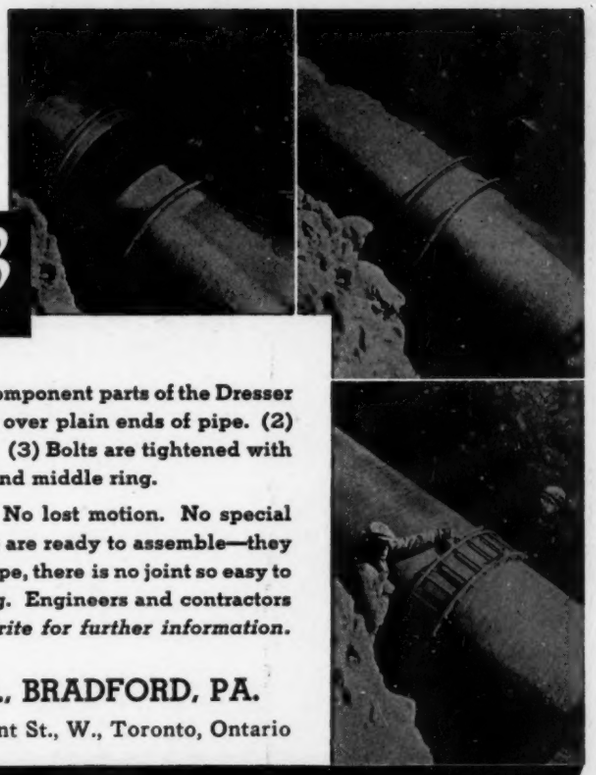
▼

Haight of Des Moines Is Distributor for Bucyrus-Erie

Bucyrus-Erie Co., South Milwaukee, Wis., announces the appointment of Haight Tractor & Equipment Co., 1214 Mulberry St., Des Moines, Iowa, as distributor in the central and eastern portions of Iowa. The Haight Tractor & Equipment Co. will handle Bucyrus-Erie machines ranging from ⅜- to 2-yard capacity—shovels, draglines, cranes, clamshells, dragshovels and skimmer scoops. A branch office of this distributor is maintained at Clinton, Iowa.

No matter how large or how small the pipe . . . Joint-Making is as

Simple as 1·2·3



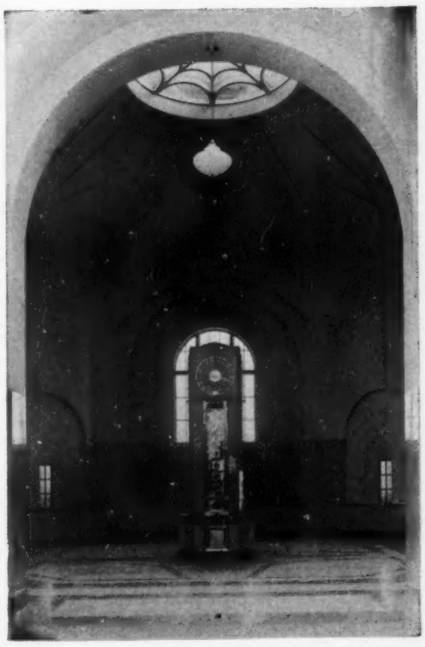
THREE pictures tell the story of Dresser simplicity. (1) Component parts of the Dresser joint—followers, gaskets and middle ring—are slipped over plain ends of pipe. (2) Pipe ends are shoved into middle ring, and bolts inserted. (3) Bolts are tightened with ratchet wrenches, to compress gaskets between followers and middle ring.

Almost as easy as mounting a spare tire on a wheel! No lost motion. No special tools nor equipment. No skilled labor. The Dresser parts are ready to assemble—they fit correctly . . . go together in a jiffy. On 60" pipe or 3/8" pipe, there is no joint so easy to make . . . nor so permanently tight . . . as a Dresser Coupling. Engineers and contractors everywhere are enthusiastic over Dresser advantages. *Write for further information.*

S. R. DRESSER MANUFACTURING CO., BRADFORD, PA.

In Canada: Dresser Manufacturing Co., Limited, 32 Front St., W., Toronto, Ontario

with DRESSER COUPLINGS



TORONTO, ONT.

Gore, Nosmith & Storrie, Consulting Engineers
W. J. Westaway Co., Ltd., Contractors

Of striking appearance is the unique, artistic pylon which will greet the visitor to the City of Toronto's new Filtration Plant now nearing completion.

In the main operating and pipe galleries Builders Iron Foundry Effluent Rate Controllers, Gauges, and Master Control equipment will have a large share in the attractiveness and efficiency of this great purification plant.

FOLLOW THE BUILDERS CAMERAMAN
as month by month he shows views of interesting installations.

BUILDERS IRON FOUNDRY

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PROVIDENCE • R • I •

Bulletin 260—Venturi Meters for Main Pipe Lines
Bulletin 232 — Venturi Direct Acting Controllers

Bulletin 273—Chronoflo Telemetering System, transmitting flow, pressure, or level measurements for "hundreds of feet or hundreds of miles."

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Water Supply, Treatment, Sewerage Reports, Plans, Estimates.
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25 W. 43rd St., New York, N. Y.

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CAN WE HELP YOU?

On other pages in this issue you will find described new and improved equipment, etc., as well as reviews of recent trade literature received by us. By requesting the literature described you will be able to keep your catalog file complete and up to date.

To our readers desiring additional help or information we will be glad to assist you in securing more complete information or data on any equipment or product you need. Use the convenient blank below—No cost or obligation.

WATER WORKS & SEWERAGE
155 East 44th Street, New York, N. Y.

Gentlemen:—

We are interested in the following items and would appreciate your assistance in securing more complete information.

....
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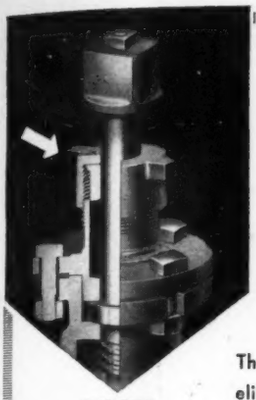
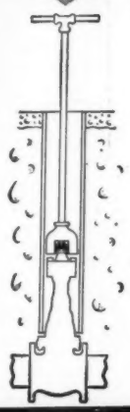
..... **NAME** .....
..... **POSITION** .....
..... **ADDRESS** .....

Yes—we would like you to mention WATER WORKS AND SEWERAGE.



Tightened from the Ground Level



The Coster Patented Stuffing Box eliminates costly digging — saves money—tightening as easily as opening or closing the gate. Now you can get Ludlow Gate Valves with this improvement in both screwed and bolted bonnet types. Send for folder describing the full line.

P. S. Do you use Dresser Couplings? We manufacture a complete line of Dresser equipped valves. Send for details.

The LUDLOW VALVE MFG. CO.
TROY, NEW YORK

PREVENT *Water* POLUTION ... *with* STEWART FENCE

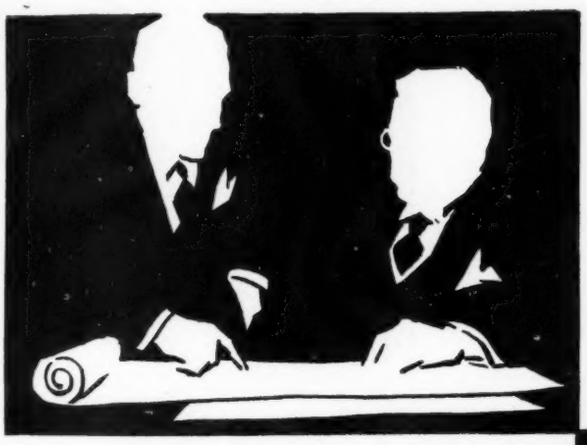
The time is here for picnickers, bathers and fishermen to advance on the property under your protection. Thoughtlessly they clutter up the grounds with dangerous debris . . . unknowingly they contribute to water polution.

Stewart Chain Link Wire Fence keeps them out of "no - trespassing territory" . . . controls their wanderings and eliminates careless and malicious damage.

Write for a catalog.

THE STEWART IRON WORKS CO., Inc.
112 Stewart Block
CINCINNATI, OHIO

Stewart IRON and WIRE **FENCES**



"There's a line that will last longer than the bonds, Fred. It's all time-tested Reading GPWI* Pipe."

*Genuine Puddled Wrought Iron

For facts from experience that will help you choose pipe wisely, write

READING IRON COMPANY
PHILADELPHIA

SCIENCE AND INVENTION HAVE NEVER FOUND A SATISFACTORY SUBSTITUTE FOR GENUINE PUDDLED WROUGHT IRON

ANTHRAFILT

keeps gravel filter beds flat

Experience has shown that the gravel beds of filters do not channel when Anthrafilt is used as a filtering medium. Anthrafilt is 55% lighter than sand and free from cementitious tendencies—which accounts for this advantage.

With a higher percentage of removal of bacteria and turbidity, Anthrafilt is far superior to sand as a filtering medium.

In successful use on a large scale in eight modern filtering plants. Write for references, sample and full information.

THE HUDSON COAL CO.
SCRANTON, PA.

G. B. FILLMORE
General Sales Agent

LACKAWANNA "the D&H" ANTHRACITE

H. H. SHAVER
Asst. Gen. Sales Agent

IMPORTANT!

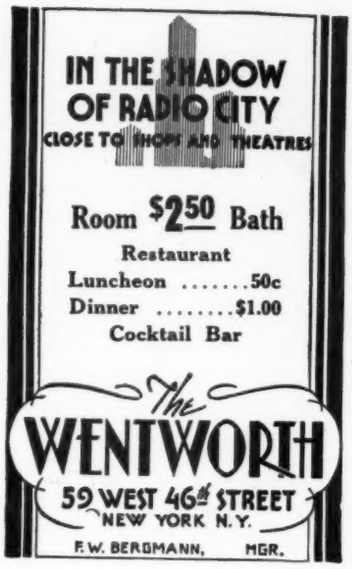
The September Issue Will Be Distributed at the 54th Annual Convention New England Water Works Association Providence, R. I. Sept. 17-20, 1935

Send in Your Space Reservations Early

WATER WORKS AND SEWERAGE

155 E. 44th St. New York

400 West Madison St. Chicago, Ill.



POSITIONS WANTED

This department has been started as a service to those in the Water Works and Sewerage Fields. We hope they will make use of it. The notices are inserted without charge.

CIVIL ENGINEER; 1933 graduate of the Univ. of Illinois with M.S. in Sanitary Eng. Have 7 months' experience in building construction and drafting. Desire any permanent engineering position with opportunities of temporary position giving good experience. Age 23 years. Capable of hard work. Location immaterial. Wm. Hasfurther, 7723 S. Ada St., Chicago, Ill.

CHEMIST AND BIOLOGIST—Analytical Chemical Analyses, Biological examination of water for all purposes. Sewerage and industrial waste investigation and research. Age 34. 10 years' experience. D. E. Singer, 210 West 101st St., New York, N. Y.

POSITION WANTED—B.C.E. from recognized engineering school, '35. Age 23; single. Desires position in field of civil engineering. Location immaterial. References on character, etc., furnished at request. Available at once. Address G. S., % Water Works and Sewerage, 400 W. Madison St., Chicago.

WATER WORKS SUPERINTENDENT—With ten years' experience and last three years Superintendent Water Works at Vidalia, Ga., desires change. Prefers Southern State. Available July 1st. References as to character, ability and competency supplied upon request. 38 years of age; married and family of six. Address L. E. K., Water Works and Sewerage, 155 East 44th St., New York City.

CIVIL AND SANITARY ENGINEER; B.S., Civil Engineering, 1933; M.S., Sanitary Engineering, 1935. One year Public Health experience as Sanitary Engineer. One year legal training. Age 23. Available immediately. Address H. Meyer, 1419 S. Homan Ave., Chicago, Ill.

POSITION WANTED—Sanitary Engineer, experienced in design, trained in research, and with five years' experience in technical sales work. Thoroughly familiar with the sewage treatment field, considering either men or methods. Married, 32 years of age, no preference as to locality. Address Robert Newton Clark, % Water Works and Sewerage, 155 East 44th St., New York City.

CIVIL ENGINEER—Age 31, married, graduate of Pennsylvania State College. Three years' experience State Department of Health, three years' operation and laboratory control of water filtration plants. Desires position in water works field. Address C. R. K., Water Works and Sewerage, 155 East 44th St., New York City.

WATER WORKS SUPT.—Five years' experience in present position operating small town water and sewerage plant, doing all own bookkeeping, meter reading, personal supervision of operations. Prefer Southern State position. Best references furnished from present employee's. Age 45, family four. Address H. H. C., Box 92, Lewisville, Arkansas.

CIVIL ENGINEER—Master's degree in sanitary engineering, University of Illinois, 1934. 7 mo. experience in construction work and drafting. Location immaterial. Age 23. Experience more desirable than starting salary. W. Hasfurther, 7723 S. Ada St., Chicago, Ill.

CLEARING HOUSE

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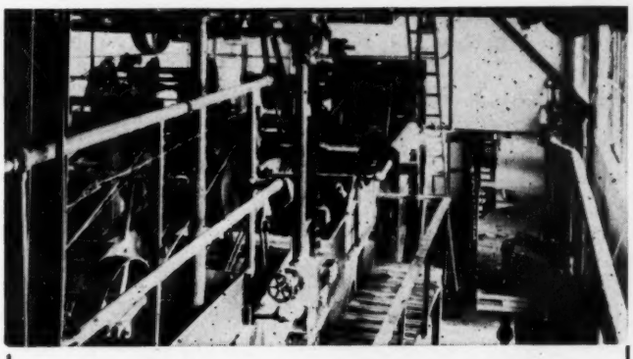

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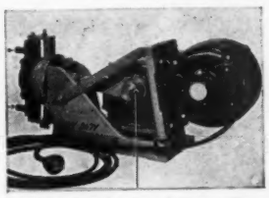

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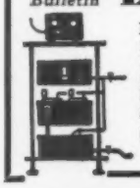

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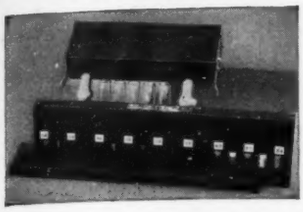

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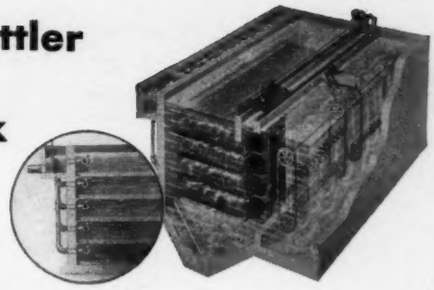

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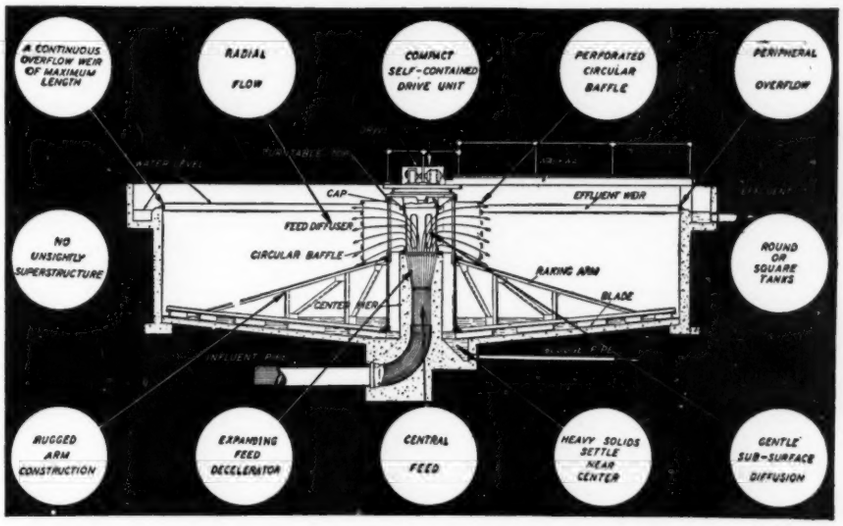

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